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Kalle Piirainen, Markku Tuominen, Kalle Elfvengren, Samuli Kortelainen, Veli-Pekka Niemistö

Developing Support for Scenario Process: A Scenario Study on Lappeenranta University of Technology from 2006 to 2016

LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
Faculty of Technology Management
Department of Industrial Management
Laboratory of Innovation Management

P.O. Box 20
FIN-53850 LAPPEENRANTA
FINLAND

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ABSTRACT

Authors: Kalle Piirainen, Markku Tuominen, Kalle Elfvengren, Samuli Kortelainen, Veli-Pekka Niemistö

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Recent developments have revealed that uncertainty is no stranger to governmental organizations anymore. Similar development, labeled as globalization, information economy and such have shaken the private sector, resulting in increased interest in management techniques for alleviating the well-known troubles, which stem from uncertainty. This report describes one possible approach to manage uncertainty in public and private organizations, namely scenario planning, or scenarios.

This report can be positioned in the continuum of previous studies of scenario planning undertaken in Lappeenranta University of Technology. For this particular report, the purpose is to provide an overview to the present state of practice and the results of some of these sessions, and package them to a usable form for decision makers. As for the content, the report describes a tested concept of supported scenario process and the resulting scenarios for Lappeenranta University of Technology. Thus the contribution of this report is to provide an overview to and an example of one way to reduce uncertainty in an organization in and efficient manner by utilizing support tools in scenario process

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1 INTRODUCTION

In these days, it could be perhaps considered banal to start a report by referring to change and uncertainty as important factors, as the university has gone through a major restructuring and quick overview of recent publications by the Ministry of Education reveals that uncertainty is no stranger to governmental organizations anymore. Similar development, labeled as globalization, information economy and such have shaken the private sector, resulting in increased interest in management techniques for alleviating the well-known troubles, which stem from uncertainty. This report describes one possible approach to manage uncertainty in public and private organizations, namely scenario planning, or scenarios.

This report started as a method development exercise in the Laboratory of Technology Management and Group Support Systems for finding and testing support methods for scenario planning. Scenarios have been studied and used in Lappeenranta University of Technology (LUT) for example in the context of technology management and innovation process, and these exercises can be seen in the same continuum. Where the previous work has focused in the issue of utilizing scenarios in innovation process and supporting knowledge transit, the present studies have been mostly concerned with the process and methods of scenario planning.

Out of these test sessions and the valuable contribution presented by a group of participants, who were kind enough as to lend us their time, roots also the set of scenarios presented in this report. For this particular report, the purpose is to provide an overview to the present state of practice and the results of the session, and package it to a usable form for decision makers. As for the content, the presented supported scenario process has been tested in multiple sessions and the reported scenarios are based on the joint insight of a group of experts who participated in the GSS supported workshops.

With these sentiments, the report should be considered as a descriptive case study (Yin, 1994). This report does not aim to develop theory in the way of an exploratory case study (Yin, 1994; Eisenhardt, 1989) or strictly testing it. What the report does is that it presents an overview to the theoretical background of scenarios and methods for supporting the process, and *describes* an instance where the theory has been operationalized as a supported scenario process and the scenarios based on these sessions.

This report will be structured in the following manner. At first, the concept of scenarios as a method for managing uncertainty is introduced briefly and the central concepts are defined. Secondly, the report gives a prompt overview on the methods and process, which are used in these particular scenarios. As the third main chapter, the report will provide the scenarios based on the test sessions. In the last chapter, the report will present conclusion and discussion, followed by references and appendices. A casual reader may be tempted to jump straight to chapter 4, which contains the scenarios, but it is recommended to leaf through the theoretical background as the description answers questions concerning why the writers have done what they have done, and gives a solid ground to critical evaluation of the results.

2 SCENARIO PLANNING

2.1 Uncertainty and scenarios

Change and uncertainty has been discussed *ad nauseam* at least in the more popularized writings and in the media. In addition to futures studies being trendy, there are also solid reasons for bringing them into the strategy formulation. The application of organizational strategy as traditionally associated with the private sector is nowadays commonplace in the public sector, with its advantages and pitfalls all the same. One of these pitfalls is uncertainty presented by changing environment, which poses threats to the operational conditions of a given organization and may render its careful planning and strategizing useless (Mintzberg, 1994). Most strategic writings of the practical persuasion, e.g. Porter (1985), Coyle (2004), Johnson and Scholes (2002), start with profiling the organization in relation to its surroundings and environment. Presently universities operate in similar conditions as other organizations, in the 'industry' of education, where their rivals are other educational institutes, their customers are students and research is their product.

Figure 1 depicts the ways of managing uncertainty according to Coyle (2004, p. 49). The basic approaches are of course passive and active. Passive strategist, either relies on the plans and hopes, ignores or copes with the consequences. The other crossroad is between sharing the risk and anticipating the consequence. Insuring or shifting the risk works for situations where the risks are more of the everyday variety, the more serious uncertainties concerning the organization's ability to operate in the future deserve more attention. The final choice up the tree is between quantitative and qualitative methods. Quantitative methods include classical forecasting activities, trend analysis, game simulations, system dynamics modeling, real options et cetera. The cognitive (qualitative) methods are narrative studies and systematic assessment methods or the scenario approach.

As in theory of science, the battle between quantitative methods and comparable "softer" methods rages on. There are persuasive arguments for each camp. Overall, quantitative methods have similar limitations than any other. The most obvious limitations are: 1) any mathematical representation, model or analysis is as good as the data input it uses, 2) if the properties and axioms of a model are not understood or get ignored, the calculated results are most likely erroneous or misleading 3) the resulting analysis may be incorrect or, if the analyst and the user of the results are not the same person, the results may be incorrectly interpreted. Additionally, Aiolfi & Timmerman identify "model instability" or the choice of best performing and correct model as the greatest error source, if not in fact virtually impossible. (Aiolfi & Timmerman, 2006; Mintzberg et al. 1998 p. 67; Golden et al. 1994)

The same pitfalls of seeing patterns in randomness and seeking the convenient truth plague quantitative and qualitative methods. If there is a doubt about pitfalls of forecasting, one can remind oneself about the "permanent and high plateau" of stock prices in the summer of 1929, or read the book Dow 36,000 from September of 1999 (Thornton, 2003, p. 8).

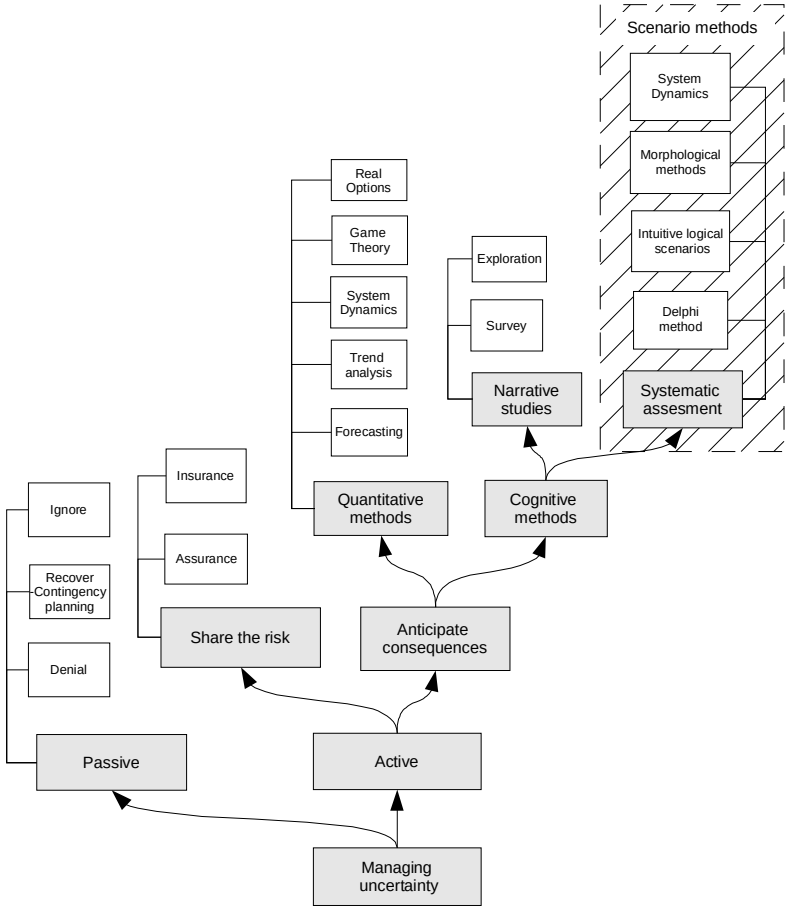

Figure 1. Methods for coping with uncertainty and risk (adapted from Coyle, 2004, p. 49, Bradfield et al. 2005)

During the last decade or two a consensus has formed at least in the less deterministic side of theory of science that quantitative or qualitative methods are not better or worse than each other *per se*, when applied properly (e.g. Silverman, 2005; Eskola & Suoranta, 1998) but rather complementary. Anyone who has taken a course in statistics knows how easy it is to use the most sophisticated methods and end up with an analysis that can be dismissed straight away. The question of reliability is about the Bermuda triangle of analysis: reliability of the data source and integrity of collection process, the choice of correct methods and execution, and the right interpretation of results.

The industry of forecasting as seen today is largely associated with strategic planning in its traditional form (discussed thoroughly in Mintzberg 1994). The requirement for 'hard' quantitative data has lead to mathematically sophisticated modeling and forecasting methods. Seemingly planning has a deterministic assumption that strategy formulation is a disciplined act reasoning and induction to determine the correct moves for an organization's success (Mintzberg, 1994, p. 67). Forecasting has similar assumptions that by manipulating data of past and present, accurate projections of the future are trivial as long as correct methods are used with the proper procedure. Ironically Golden et al. (1994) explicitly criticize forecasting practices for about every single fallacy usually associated with the more intuitive methods.

The other quantitative methods, like system dynamics, real options or other modeling methods are largely open to the same critique than forecasting. Put simply, real options are about reducing decision options to a path dependent series of investments, which then tells the most profitable path in the same manner as, say a decision tree (Adner & Levinthal 2004), and allows to "buy options" to resources or markets with partial investments (Miller & Waller, 2003). System dynamics in turn are based on Jay Forrester's industrial dynamics, where the chase is to model behavior of entities through relations, delays and feedback. By definition, a model is a simplification of a real problem, often described in the language of mathematics. Thus, the modeling approach has the same error sources as described above; the first pitfall is deciding what the relevant parameters are that need to be included in the model, the second is the choice and forming of the decision model and the third is of course interpretation.

Before going any further, it may be in order to fathom that the purpose of this study is not to make forecasting or modeling the whipping boy for failed attempts of strategizing, but to establish a reasonable doubt for other methods for dealing with uncertainty. It cannot be claimed that modeling or forecasting would not be useful when used properly; the point is that they are as mundane and vulnerable methods as the next one.

This leaves two options, narrative studies and scenarios. The general idea in narrative studies, according to Coyle (2004), is the act of imagination and expertise by a writer who explores the future based on a literature review, expert knowledge or both. The results range from Orwell's novels to something resembling full-blown scenarios. For the sake of equality, it has to be said that narrative studies a concept is perhaps not the most convincing. The reliability issues of qualitative data are well known, and the validity of narrative studies lies solely in the hands of the writer.

If there is any superiority in scenario approach, it is the built in redundancy and versatility. Independent of the actual scenario method, the standard of practice has formed so that scenario planning concerns multiple scenarios, be the method based on intuition and logic or trend analysis and morphological methods, see e.g. (Bradfield et al. 2005; Coyle, 2004; Schwartz, 1996; Schoemaker, 1993). The other feature is that scenario process can in fact include various methods, including forecasts, real options, intuitive reasoning or strategic programming. The scenario approach has received critique for ambiguity of terminology and methodology, but the other side of the is that scenarios can in fact be seen as a carrier for substance which sets the form of the process and lets the practitioner adjust methods as needed (Bradfield et al. 2005).

In addition to Coyle, also other management scholars have addressed the scenario approach, Mintzberg (1998) seems cautiously positive in referring to Porter's (1985, p. 445) thoughts on the subject. Porter (Ibid.) criticizes strategy formulation for being based on conventional wisdom, and forecasting activities which in his view tend to smoothen the expectations unnecessarily. Walsh (2005) also proposes the scenario approach as a kind of a standard method for strategy development with much of the same reasoning as reported above. Between scenario practitioners and scholars, there is an unsurprising consensus that scenarios are usually the most fit and versatile way to manage uncertainty (Stauffer, 2002) but i.e. Schoemaker (1993) stresses that scenarios gain appeal as complexity and uncertainty of a situation rise.

For the sake of comparison, Table 1 draws together the described methods for dealing with uncertainty. Based on the consideration described above, the scenario approach seems most feasible, as it flexes to different needs and seemingly avoids the most obvious fallacies of futures methods. As shown above, the reasoning for use of scenario methods is somewhat compelling. Surprisingly there is relatively little critique for the scenario approach, which of course does not mean that it would not have pitfalls of its own. The creativity and methodological freedom of the scenario approach can be seen as a double-edged sword; it gives freedom to the practitioner to choose appropriate method, but declines the possibilities for *ex post* reliability governance. With mathematical methods, data source reliability and proper use of models are relatively easy to address, but scenarios often leave the reader hanging on subjective reliability evaluation. And of course there are no guarantees in scenarios any more than in forecasting, even well-known scenario practitioner and popular writer Peter Schwartz managed to publish visions of unforeseen period of prosperity spanning decades ahead in fall of 2000 (Stauffer, 2002).

Table 1. Strengths and weaknesses of futures methods (De Gooijer & Hyndman, 2006; Adner & Levinthal, 2004; Coyle 2004; Forrester, 1998; Golden et al. 1994; Schoemaker, 1991)

Method	Forecasting	System Dynamics	Real Options	Scenarios
Strengths	- Numerical results - Convenient trend and time series analysis - Relatively easy process	- Numerical results - Convenient multi-parameter simulations - Dynamic nature of model	- Numerical results - Easy comparison of decision options - Clear presentation of decision options - Supports early engagement in ventures - Illustrates profit impact of decisions	- Flexible - Dynamic in nature - Redundancy - Structured method - Simple process if wanted
Weaknesses	- Vulnerable to biases - Only as good as the data - Doesn't behave in discontinuous conditions - Mostly single or dual variate methods	- Requires expertise - Laborious model building - Vulnerable to subtle errors in modeling	- Vulnerable to exogenous changes - Built in pitfalls can lead to great losses - Probability and cash flow estimates	- Vulnerable to biases - Qualitative nature of results - No universal modeling heuristics

2.2 Origins and background

Depending on the author, scenarios or scenario planning can be seen as rooting from very different sources. One proposition comes all the way from ancient Greece, as the word scenario can be seen as etymologic father of the word "scene" in theatrical terminology (Ogilvy, 2002). Other popular suggestions are the Manhattan Project simulations in 1940's to find out if the Bomb would literally light up the skies, or even the Strategic Missile Command early warning system (Bradfield, et al. 2005; van der Heijden et al. 2002; Schoemaker, 1993). The dawn of scenario planning, as it is known today, dates back to the 1960's. The credit of being the *primus motor* has been given to Herman Kahn, who at the time worked with the RAND Corporation, although Gaston Berger worked on the same

lines at the same time when pondering the future of France (Bradfield, et al. 2005; Schwartz, 1996, p. 7).

In its infancy, scenario planning was mostly used for military purposes in the new world and for governmental planning purposes in Europe. The break through in business was in the early 1970's when Pierre Wack, being familiar with Kahn's work, started to experiment with scenario planning in Royal Dutch/Shell. The landmark of scenario planning, also widely popularized, is Wack's first scenario set which supposedly predicted the oil crisis in the seventies, but at the time Shell largely failed to act according to what the scenarios would have commended to. Today the field of scenario planning is rather scattered, Bradfield et al. (2005) go as far as describing the situation as a methodological chaos. The reason for this is that every practitioner has a different emphasis and views. The two main schools are Kahn's American school and Wack's French or *La Prospective* – school. Inside these camps, the variety of methodologies can be further divided to Intuitive-logical, *La Prospective* and Probability –models. Figure 2 depicts the pedigree of the basic scenario approaches. As Bradfield et al. (2005) point out, since the beginning; the variety of scenario techniques and applications has broadened substantially. The scenario approach is rooted in relatively straightforward techniques and has evolved to a variety of more or less intricate views, with a trend of applying more "scientific" modeling and analysis techniques.

In the beginning of scenarios the scope was usually at the state or global level, and time horizon spanned up to forty years forward, but the modern uses include innovation management and technology selection, organizational strategy formulation, operational strategizing and military applications, and time lines can as short as a few years. (e.g. Ralston & Wilson, 2006; Naumanen, 2006; Kokkonen et al. 2005; van der Heijden et al. 2002)

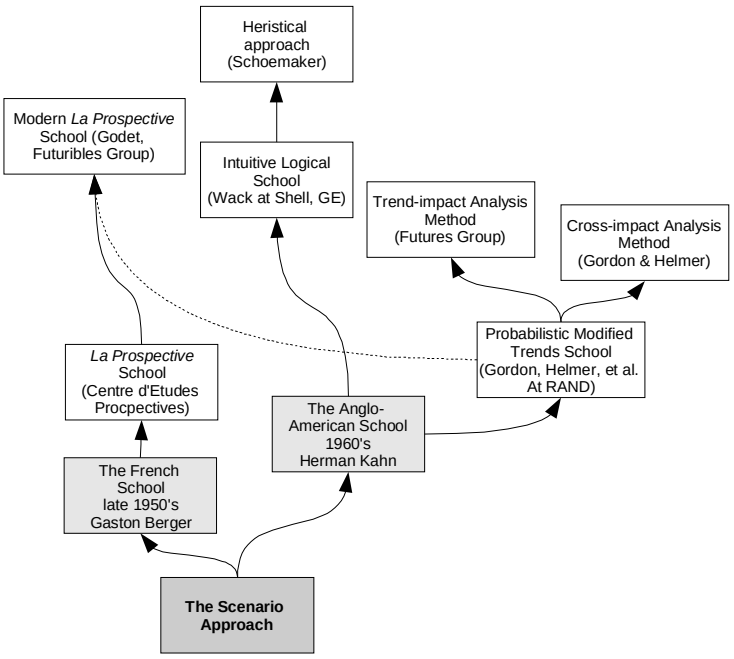

Figure 2. Evolution of scenario techniques (Bradfield et al. 2005; Millet, 2003; van der Heijden et al. 2002; Schoemaker, 1991)

2.3 Definitions

Starting from the very beginning, Kahn and Wiener (1967, p. 33) define scenarios as "Hypothetical sequences of events constructed for the purpose of focusing attention to causal processes and decision points" with addition that each situations development is mapped step by step and each actors decision options are considered along the way. The aim is to answer questions "What kind of chain of events leads to a certain event or state?" and "How can each actor influence the chain of events at each time?"

Schwartz (1996) describes scenarios as plots that tie together the driving forces and key actors of the environment. In Schwartz' view the story gives a meaning to the events, and helps the strategists in seeing the trend behind the seemingly unconnected events or developments.

Ogilvy (2002, p. 176) expresses this more poetically; his view is that, like in a proper tragedy, a scenario should have beginning middle and end. Ogilvy's (Ibid.) spin is that creative and attractive stories arouse the readers' imagination, thus helping in adopting the ideas of change and facilitating action.

Schoemaker (1995; 1993; 1991) writes that scenarios simplify the infinitely complex reality to a finite number of logical states, by telling how the elements of a scenario relate with each other in a defined situation. In Schoemaker's view scenarios as realistic stories might focus attention to perspectives, which might otherwise end up overlooked.

Coyle (2004, p.57) defines scenarios as justifiable and traceable chains of events, which can reasonably expected to happen in the future. Coyle's stress is that scenarios are stories of the future rather than descriptions of conditions at a defined time, and that the key is not accurate prediction but the process, which is supposed to lead the decision makers to ponder boundaries of the future outside their usual frame of mind.

Chermack (2004) agrees with Coyle in that scenarios and the process involved sensitize the people involved to better consider changes in the environment. He also sees scenario process as a way to enhance decision making processes in an organization, as a resultant of knowledge convergence experienced in a successful scenario process.

Table 2. Definitions and uses of scenarios

	Kahn & Wiener (1967)	Ogilwy (2002)	Schwartz (1996)	Schoemaker (1991)	Coyle (2004)	Porter (1985) Walsh (2005)
Form	Story, descriptive	Story, descriptive	Story, (normative)	Story, descriptive	Story, descriptive	Story, normative
Use, perspective	Macro level, global and state level developments	Macro level, Changes in society, values	Macro level, Organizational strategy	Macro level, Organizational strategy	Industry level	Industry level, organizations' positions
Emphasis	Detailed, elaborate, broad sight	Values, social structures	Learning as a result of the process	Relations in the operational field	Directing of actions, shaping paradigms	Environment analysis, positioning
Time horizon (approx)	<40	<20	<15	<10	<10	<10

From the definitions stated above, one can derive that scenarios are a set of separate, logical paths of development, which lead from the present to a defined state in the future. Furthermore, it can be deducted that scenarios are not descriptions of a certain situation some time in the future, nor are they a simple extrapolation of past and present trends. Table 2 illustrates different views of scenarios, outside the core definition there are many different views, ranging from very elaborate normative scenario sets with well-defined scenarios and decision options to narrower descriptive scenarios with the mandate of affecting decisions mostly through the process.

Figure 3 provides further illustration of scenarios, for clarifying the concepts. As of this point, a single scenario is referred to as a scenario and multiple scenarios developed as a set are referred to as scenarios. The other dimension in scenarios is the relationship of entities in a scenario set. Some writers (e.g. Blanning & Reinig, 2005) use the concept of "drivers of change" to describe forces, such as influential interest groups, nations, large organizations and trends, which shape the operational environment of organizations.

The interpretation used in this study is that these drivers create movement in the operational field, which can be reduced to a chain of related events. These chains of events are in turn labeled as scenarios, leading from the present *status quo* to the defined end state during the time span of the respective scenarios. It may have to be noted that it is not assumed that a driver has one defined state, but multiple possible states. Thus, a driver can influence multiple events, which may or may not be inconsistent in a given set of scenarios, but of course, according to the definition of a scenario, not in a single scenario.

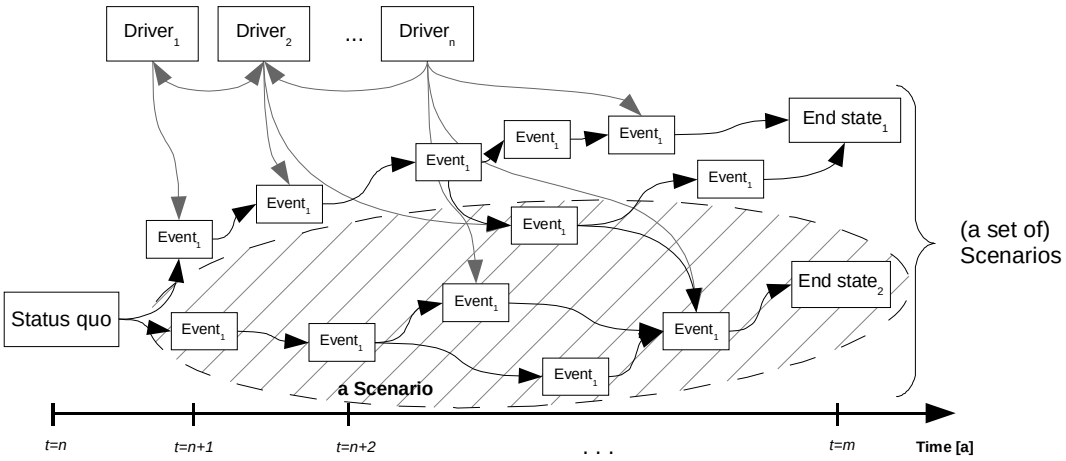

Figure 3. The relationship of drivers, events and scenarios (a single scenario highlighted, driver relations depicted with the gray arrows)

As implied above, the types and applications of scenarios are varied, which results in some ambiguity on terminology and typology (for more discussion see, Piirainen, 2006). Henceforth scenarios, which focus in one organization or its position, are called intra-organizational and scenarios, which are aimed to describe environment in a broader level with no assumptions of the organization itself affecting the events, are called inter-organizational. The other dimension can be condensed to the difference of drivers as the

underlying logic of scenarios. If considering the drivers that are exogenous, as in the organization has no control over them, and the scenarios describe events triggered by foreign forces. In the opposite case, endogenous scenarios describe the path stemming from the organizations path of development, and the resulting events are triggered by drivers that are under the control of the organization.

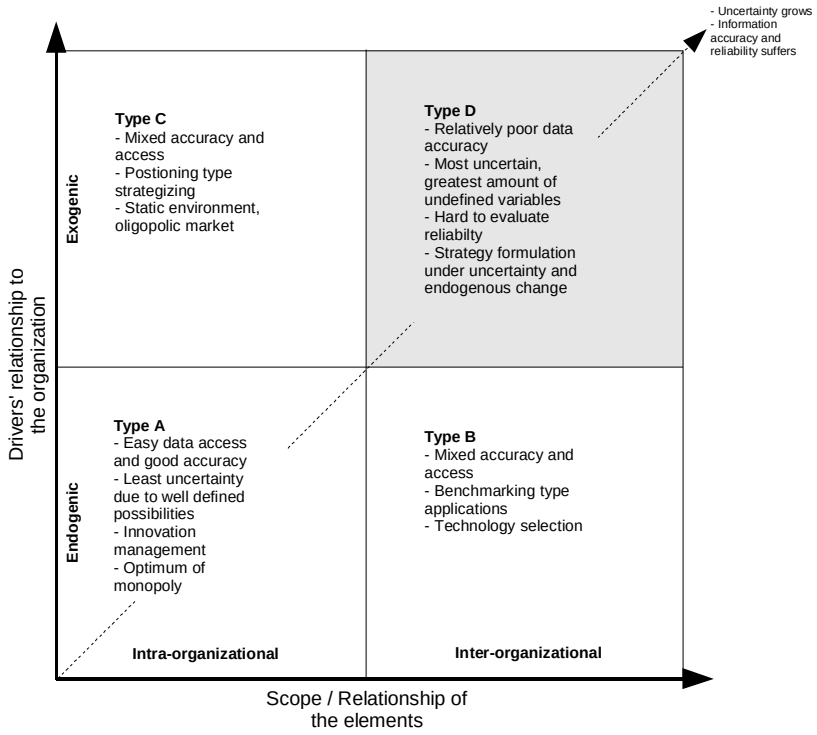

Figure 4. Different types of scenarios

Type D scenarios are the most widely reported case, as perhaps the most typical use of scenarios has been analysis of operating environment and its uncertainties through the possible effect of changes that happen outside the organization, which can not be easily controlled (see e.g. Walsh, 2005; van der Heijden et al. 2002; Schoemaker, 1993; Porter, 1985). One factor for this may be also the traditional view in strategy, that the organizations properties are taken as given and static at least to some extent, so it is the environment, which is seen as changing relative to the organization performing the analysis. In the context of this study, type D scenarios are the most significant instance, as nothing is assumed about the balance between organizations or the speed of change in structures, so it is in order to assume the worst.

In similar manner the flexibility of methods can be seen a classifying factor when discussing scenarios. Based on the consideration about different uncertainty management and scenario techniques, these methods can be put into order by methodological stiffness. Different scenario methods have their own requirements and assumptions and similarly it can be suggested that they have, figuratively speaking, own methodological sweet spots. Each method naturally has its strength and weaknesses as already discussed above, but e.g. Schoemaker (1995) considers the extremities in methods as risky; on one hand in intuitive approach the results may be too creative in order to win trust, and on the other hand statistic approach tends to be mechanical and doesn't encourage innovativeness. In this

study, most effort is put into intuitive or heuristic approaches, as they have the least structure and they are also criticized the most for this. Bradfield et al. (2005) also point out that model-based methods tend to be too demanding to be conducted inside the firm, and in turn need experts or consultants to do the modeling and analysis.

The scenarios discussed in this report can be characterized as type D intuitive logical or heuristic scenarios, where the focus is on the environment and its effect on the organization, rather than the other way round. What this assumption gives to a scenario practitioner is the insight on the impact of exogenous uncertainty to the path of the given organization, which could be also seen as a fruitful perspective on LUT in these present conditions. However, it is arguable that present organizational changes have their own effect, which is of course true, but that does not erase the effect of exogenous factors but rather opens a new perspective for new scenarios.

2.4 Preferred qualities in scenarios

Now that definition of scenarios is established, the next step is to discuss what qualities should be achieved in the scenario process. Even though the process is the goal, it can be considered useful to stop for a moment, to think what the preferred outputs are. Dressed in a cliché: it is not enough to do things the right way, one should be concerned if one is doing the right things.

According to definition, scenarios are sequences of events. Many writers also stress this chain must be detailed enough, in order to give ground to interpreting which scenario(s) is about to materialize (Ogilvy, 2002; Schoemaker, 1991; 1995; Kahn & Wiener, 1967). The justification of the scenario approach is that in an uncertain situation, the path of development can be recognized at an early stage in order to influence the chain of events or start damage control measures in time.

In contrast, even if a good scenarios is detailed, it has to be comprehensible and manageable. Looking at Kahn and Wiener's (1967) scenarios "The Year 2000" in all its 300 page glory; it has predicted many developments with surprising accuracy and in it's time has had a wealth of useful information, it still comes apparent that it might fairly easily overload an unwary reader. The optimum of depth and breadth depends on the audience, use or purpose and the severity of the situation, being a compromise of manageability and detail.

Third point is relevance to the decision makers. The relevance starts from the corner stones of actors and drivers; it can be argued that, at least in infinite span, everything is connected in some way or another, but a reasonable cropping of the picture is necessary to keep the scenarios in some reasonable boundaries. Then again the scenario stories should not be too trimmed, so as important features are not left off and the individual scenarios remain identifiable.

The other dimension of relevance is that all other things aside, all relevant drivers and events should be included in the scenarios. At first look, this point might strike as the most obvious, but that is also the pitfall of relevance. The reason of scenarios is to break free from the safety of convention and the obvious, at least for a moment, and to explore *the possible* instead of *the probable*. Sometimes fairly insignificant innovations or events may

have surprising repercussions, for instance, five to ten years ago, the telecom industry sneered at internet telephony, but today U.S. operators are possibly facing a paradigm change because of the little innovation that could.

Next important challenge is coherence or consistence of individual scenarios. The definition of scenario adopted above was a logical and consistent chain of events from *status quo* to a defined end state. Schoemaker (1995, p. 29) defines three basic tests for consistence:

1. Are trends compatible with chosen timeframe?

2. Do scenarios combine effect of compatible drivers?

3. Are major stakeholders positioned in places that are realistic?

As an example: 1) Can open source software (OSS) movement disrupt the earning logic of the software industry, and can it happen in five years? 2) Does the trend of tightening legal governance for intellectual property rights and software patents allow OSS to develop to its full potential? 3) Are the incumbent software vendors joining the bandwagon, or do they try to raise entry barriers?

One factor of quality is the number of scenarios. Walsh (2004, p. 117) suggests that 2-4 would be optimal, although Schwartz (1996) is certain that above three would be waste. General opinion is that over four scenarios will be too much, especially if an own strategy is formulated for each eventuality and two is the obvious minimum, if the objective is to develop scenarios instead of a narrative study. Ralston & Wilson (2006, p. 120) add that when two scenarios are presented, decision makers tend to interpret them as a positive and a negative scenario which is necessarily not the case, and when presented three scenarios, the risk is that one will be taken as the most probable, resulting in a tunnel vision toward the selected direction. A reasonable approach has been introduced by Schoemaker (1995), who suggests developing 7-9 preliminary scenarios, and then choosing or combining necessary amount of final scenarios out of them.

Another major concern is preserving nuances of expert opinions and innovativeness in the final scenarios. Innovative atmosphere in the process helps thinking outside the box and nuances give depth to the story, which may help in reflecting which of the scenarios is about to unravel in near future. Scenarios do not help much if they only encompass the convenient and obvious 'truth' or the writer is the only one who bothers to read the whole set.

Lastly, there is the issue of trust. In the context of quality attribute trust refers to *subjective* trust, as noted above the reliability of scenarios can be hard to assess and the aim is not always in the absolute explicitly defined trustworthiness. In fact, Selin (2006) reminds that the subjective trust of the intended audience is what makes or breaks the final scenarios. The process and communicating the results must gain subjective trust of decision makers otherwise scenario planning will not be implemented to the actual management culture. Selin list five conditions for trustworthy scenarios, which apply to the substance of the scenarios, the scenario process and the use of scenarios:

1. The members of the group must trust each other enough to share their expert knowledge, to create reliable data for the scenarios

2. The process must meet the methodological requirements of the participants, for the results to be trusted

3. The scenario stories must be written in a trust inspiring manner

4. The substance of the scenarios must be trustworthy

5. The scenarios must be presented in a trustworthy manner

The Bermuda triangle of scenario planning forms from the three overlapping challenges; sufficient detail, relevance to the user and length. Yet a good scenario is detailed, the volume of information should be kept on a manageable level. Business managers are after all notorious of ignoring too long written documents. A relating point is keeping the scenarios relevant to decision making, there is little use of totally unrelated information and it may frustrate the reader. Summarizing the challenges of successful scenarios, Table 3 draws together the three levels of requirements.

Table 3. The levels of successful scenarios

Challenges of Scenario Composition	
1. Substance	Sufficiently detailed scenarios
	Manageable breadth and depth
	Relevance to the organization and decision makers
2. Form	Consistency and coherence of the individual scenarios
	Right number of scenarios
	Preserving the undertones and nuances in the final scenarios
3. Methodological integrity	Trust building in the process
	Trust inspiring communication of the scenarios

2.5 Scenario Process

Despite the aforementioned colorful collection of practices, there are identifiable universal elements between different proposed processes. Table 4 describes some of the more cited models according to Bergman (2005) in more detail. The table is not in any case complete, but acts as an illustration of actual scenario processes in different methods, and as a reference point to the generic process used in the course of this report from this point forward.

Starting from the first column from left, Schwartz exemplifies the intuitive approach, which largely relies on logical thinking in constructing scenarios. In the middle are two examples of heuristics methods that are more structured than the intuitive, but less than statistic ones. In far right is presented a statistic approach by Godet, which is built on modeling the environment and estimating the development on mathematical grounds. As

already implied above, the processes have all not only own characteristics each, but also their own assumptions.

Table 4. Different scenario processes (adapted from Bergman 2005)

Key elements	Intuitive approach	Heuristic approaches		Statistical approach
	Schwartz (1996)	van der Heijden et al. (2002)	Schoemaker (1995; 1991)	Godet (1993)
Defining the problem and scope	1. Exploration of a strategic issue	1. Structuring of the scenario process	1. Framing the scope 2. Identification of actors & stakeholders	1. Delimitation of the context 2. Identification of the key variables
Analyzing the key elements of scenarios	2. Identification of key external forces 3. Exploring the past trends 4. Evaluation of the environmental forces	2. Exploring the context of the issue	3. Exploring the predetermined elements 4. Identification of uncertainties	3. Analysis of past trends and actors 4. Analysis of the interaction of actors & the environment
Constructing the scenarios	5. Creation of the logic of initial scenarios 6. Creation of final scenarios	3. Developing the scenarios 4. Stakeholder analysis 5. System check, evaluation	5. Construction of initial scenarios 6. Assessment of initial scenarios 7. Creation of the final learning scenarios 8. Evaluation of stakeholders	5. Creation of the environmental scenarios 6. Building the final scenarios
Implications	7. Implications for the decision-making 8. Follow-up research	6. Action planning	9. Action planning 10. Reassessment of the scenarios and decision-making	7. Identification of strategic options 8. Action planning

Despite obvious differences in approaches, there are common elements across the field of scenario planning. These characteristic elements are: 1) Definition of the problem 2) Analyzing the key elements, i.e. the drivers of change and uncertainties 3) Developing (preliminary) scenarios 4) Evaluation of results and revision 5) Creating final scenarios, and 6) Implementing the scenarios to decision making. Figure 5 below illustrates the adaptation of a generic process adopted for this study.

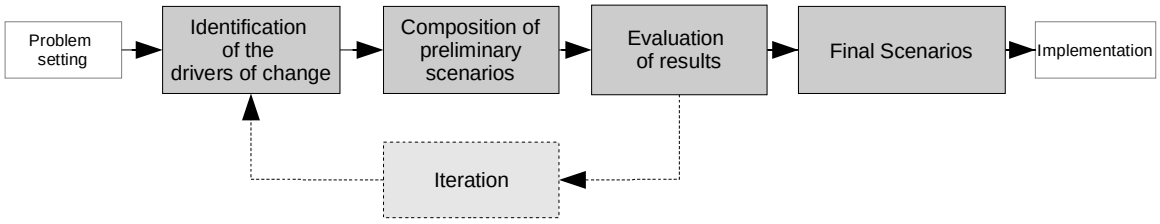

Figure 5. A generic scenario process

In context of organizational strategy formulation, the problem setting is formed according to the strategy process, but at least the time span and type of scenarios and the methods should be addressed (see typology above). Defining the basic guidelines has a lasting impact on the results, so it does not suffice so to say, just to whip up some scenarios.

The first step of the actual scenario process is identification of the drivers of change, as the scenarios were defined in Figure 3; the drivers are indeed driving the uncertainties, so the

scenarios should be based on identifying the source or cause of the uncertainty. Depending on the actual method, the uncertainties can be identified through e.g. trend exploration, brainstorming.

The second step is the composition of (preliminary) scenarios. These scenarios should be again derived from the drivers, and they should be fairly consistent and independent, even though the next step is evaluation of the results. As discussed above, Schoemaker proposed developing excess amount of scenarios and then choosing or combining the required set from them. In the same way, Schwartz (1996) proposes that the initial scenarios should be evaluated and if the results are satisfactory and seem trustworthy, then the process can move to the next stage, or if the results seem lacking then a revision is in order. Even though these cited practitioners come from the intuitive and heuristic field, the process applies to the more mechanical approaches in the same way; self-respecting modelers simulate the results with time series data to verify that the model correlates with the reality.

The third step is then forming the final scenarios. In this phase the scenarios are, at the latest, forged from events and drivers to the logical paths of development. Whereas the first steps of the process are more of a group action, the actual scenario writing can be done by a smaller group or an individual writer. Again, depending on the method, the writing may be a fairly simple write up of the event sequences or the scenarios may need some additional data.

Lastly, there is the implementation of the scenarios. At the very least, the implementation should be an overview presentation of the final results and handing of the scenario reports to the decision makers. The purpose of such occasion would be giving an idea of the scenarios and the process to the decision makers, who (should) use the scenarios, and to clear any misconceptions and doubts so that the scenarios would actually be used in the organization. As many writers propose that scenarios would have a cultural impact, would open the thinking of the organization to better consider uncertainties, or perhaps help to avert decision failures etc. (Chermack, 2004; O'Brien, 2004; Schwartz, 1996). However, it can be assumed that there is hardly an effect outside the people participating in the sessions, if the reports lay in the shelves gathering dust. In other contexts the implementation may not be a separate occasion, but handing the results over to the organizational strategy formulation.

3 CONCEPTUALIZATION OF SUPPORTED SCENARIO PROCESS

3.1 Support methods

3.1.1 Group support systems

By definition, group support systems are a collection of applications aimed to facilitate group work and communication similar to groupware (Turban et al, 2005; Jessup & Valacich, 1999). In the general hierarchy of decision support systems (DSS), GSS is placed in the branch of communication driven DSS (Power, 2002). Without going into too much detail, GSS implementations generally feature tools for idea generation, prioritization, commenting and discussion, packaged into a software suite (Turban et al., 2005).

Generally, GSS-tools are perceived as an effective way to mediate meetings, share information and achieve consensus on decisions concerning un- or semi structured problems (Turban et al. 2005; Power, 2002; Aiken et al. 1994). In recent studies, it has been suggested that GSS would particularly enhance "exchange of unshared information" (Garavelli et al., 2002) which could be interpreted so that GSS facilitates communicating also tacit knowledge. Despite the positive overtone in most studies, Fjermestad and Hiltz (1999) conclude that actually studies concerning GSS efficiency as a whole would indicate that the difference compared to unsupported face-to-face meetings is insignificant or inconclusive. Limayem et al. (2005) explain this by noting that the usual mode of GSS research takes the actual group process as a "black box" and focus on varying and describing the inputs, and on studying the *ex post* attitudes toward the process.

GSS methods have also gained critical attention among researchers. One great drawback, also considering scenario process, is that some nuances of human communication are lost in electronic communication. Although this can at least partly be averted by including verbal communication when appropriate. Other big consideration is effectiveness of input compared to traditional means of communication. The magnitude of this issue depends largely from the people participating, the factors being habituation in electronic expression and development of suitable mental models (Huang et al. 2002).

Benefits of using GSS are listed along with the challenges of scenario process in Table 5. Weighting the benefits and challenges in using GSS, seems that research findings support the possibility to facilitate scenario process effectively by means of a GSS. In many instances, GSS has been deemed effective in facilitating communication and, to some extent, improving group cohesion and idea generation (e.g. Benbunan-Fich, et al. 2002; Huang, et al. 2002).

In addition, idea generation is more efficient and, as an important feature, the process outcomes can be recalled and printed from the system for further use. Although one could criticize written communication compared to oral, with GSS the original input is retrievable unaltered as opposed to traditional methods. Actually, session recordings, even with full motion video, are easily within reach with modern decision room setups and hardware.

Table 5. Benefits and challenges of using GSS, (adapted from Turban et al. 2005; Power, 2002; Jessup & Valacich, 1999; Weatherall & Nunamaker, 1995)

GSS features	Description and advantages	Outcome	Challenges
Process structuring	Keeps the group on track and helps them avoid diversions: *- clear structure of the meeting; improved topic focus; systematical handling of meeting items*	Shorter meetings	
Goal oriented process	Aids a group to reach its goals effectively: *- process support facilitates completing the tasks; discussion seen to be concluded; electronic display makes the commitments public*	Improved quality of results Greater commitment Immediate actions	Learning through commitment and collaboration
Parallelism	Enables many people to communicate at the same time: - more input in less time; reduces dominance by the few; opportunity for equal and more active participation; participation and contribution at one's own level of ability and interest; electronic display distributes data immediately	Shorter meetings Improved quality of results	Sufficient amount of detail
Group size	Allows larger group sizes: - makes it possible to use tools for the effective facilitation of a larger group; enhances the sharing of knowledge	Greater commitment	Relevant and coherent scenarios
Group memory	Automatically records ideas, comments and votes: - instantly available meeting records; records of past meetings available; complete and immediate meeting minutes	Better documentation Immediate actions	Implementation to decision making
Anonymity	Members' ideas, comments and votes not identified by others: *- a more open communication; free anonymous input and votes when appropriate; less individual inhibitions; focus on the content rather than the contributor; enhanced group ownership of ideas*	More/better ideas Greater commitment	Better trustworthiness of scenarios and process
Access to external information	Can easily incorporate external electronic data and files: - integration with other data systems; effective sharing of needed information	Easier to justify the acquisition of the system	
Data analysis	The automated analysis of electronic voting: *- voting results focus the discussion; software calculates e.g. the average and standard deviation of the voting results*	Shorter meetings Better documentation	Efficient communication for knowledge creation
Different time and place meetings	Enables members to collaborate from different places and at different times: *offers means for remote teamwork*	Reduced travel costs Time savings	

Other benefits might be commitment and consensus creation through anonymity and information sharing, when participants' roles outside the session are not present with the input seen by the group, the focus would turn to the substance more than in traditional face-to-face situation. Of course, vested interests are not unavoidable when dealing with humans, but in anonymous system power distance and relations will presumably not have as great an effect as in unmediated face-to-face communication. In some sense, this would indicate that electronically mediated work methods might not be ideal for knowledge creation. On the other hand, there are also contradicting views that, due to effective information sharing and consensus creation, use of a GSS would in fact be beneficial to learning or knowledge creation in a group (Garavelli et al., 2002; Kwok & Khalifa, 1998). Fjermestad and Hiltz (2006) summarize the results of literally hundreds of papers on GSS

effectiveness to the following recommendations for which would most likely generate relatively positive effects; it would:

- Use a “level 2” system with sophisticated analysis tools built in.
- Use subjects who are likely to be knowledgeable and motivated about the task
- Aggregate the subjects in medium to large sized groups—at least 6, 10 or more is even better.
- Give the groups a facilitator and plenty of time.
- Use a task type that is most likely to benefit from GSS and is matched to the communication medium.
- A planning task is especially likely to benefit from GSS.
- If you have a decision (preference) task, use CMC, and if an intellective task, use decision room GSS.

On the subject of scenario process, little has been written directly of mediating scenario process with electronic means, perhaps the best known example is Blanning and Reinig’s method, which is described in multiple instances, e.g. (Blanning & Reinig, 2005). Studies that are more familiar are strategic planning exercises in an USAF fighter wing reported by Adkins et al. (2002) and the experiences in the early stages of GroupSystems at IBM by Nunamaker et al. (1989).

Among others, Kwok and Khalifa (1998) claim that GSS enhances group learning through active participation and cooperative working. In scenario literature, it is sometimes claimed that major benefit of scenario process is the process itself, in the sense that it opens the decision makers up to consider effects of change, also in ways that are not written down in the actual scenarios (Bergman, 2005; Chermack, 2004; Schoemaker, 1995). In this perspective, it would be feasible that GSS could add value to both the process and the final scenarios.

3.1.2 Maps as knowledge representation

If scenario process is considered as a learning experience and an instance of knowledge creation, there might be room and demand for techniques to enhance knowledge representation. For some time now, there have been many suggestions, but limited research, about maps of different flavor. The most widely featured types of maps are the Mind Map, which is even registered as a trademark, concept map, cognitive map and causal map. The main differences are that a mind map pictures a central concept and the up springing branches of relating matters, where the other maps can be used to describe multiple concepts with intertwining relations and causalities.

Despite their differences, the maps are generally used as elementary knowledge models or repositories. The advantage of concepts formed in maps is the relatively easy and quick understandability, courtesy of the graphical representation and immediately observable

relations between the elements (Perusich & MacNeese, 1997). Supposedly, the characteristics offer improved sense making to the user. On example is the classical study where examination success of groups of students with different study techniques was compared. One group used reading text as the only study method, the other made underlining, third made notes in addition to the second group, the fourth group added summarizing the text in question and the final group made mind maps based on the study material. The effect was that examination pass rate was far superior in the mind map - group, supposedly because of the sense of relation between sub-topics in a certain area of knowledge. The different kinds of maps are described in more detail below, with some illustration of the differences when used on the same subject.

The value of maps in general, would be that relatively large volumes of complex data could be presented in an illustrative manner with mapping techniques. Thinking of, say a table of correlation coefficients, the content is not very informative, but if it would be formed as a map, especially the relations of the elements would be more visual than in the raw data form. When it comes to the scenarios process, it can be proposed that for example, the drivers and their relations could be formed into a map fairly easily and perhaps the information value and usability of such map would be higher than a written document of the same subject.

As for the question, which mapping technique to use, it should depend highly on the subject. There is hardly any comparative research, which would enlighten the possible differences in acceptance and intelligibility of maps in different audiences. Causal maps offer a chance to use correlation coefficients and such quantitative techniques as reinforcement, cognitive maps suit the illustration on systems thinking and a way to identify feedback loops and such from the data and concept maps offer a touch of qualitative spice with free use of verbal descriptions in the linking phrases. What goes for mind maps, they perhaps suit best the purpose of data abstraction or summarizing.

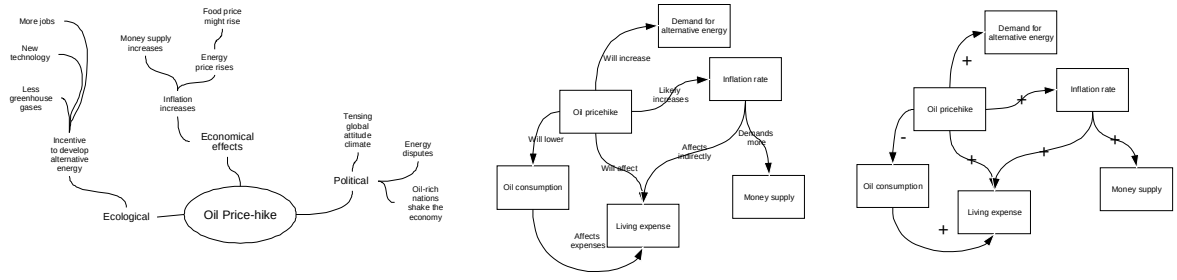

Figure 6. An illustration of different map types

In practical sense, the generation of maps is a fairly important factor in selecting the type to use. One approach would be to ask the participants of the session to draw the links during the session, or if there is a large number of elements, to ask each participant to form their own, for the scenario writer to parse a synthesis out of. The problem with this approach would be that if the maps are formed together, one or some participants may overrule the conversations and drive their opinions through, and if each is to do an own map the amount and quality of the maps may suffer, as the facilitator or the group is unable to control the situation. There would also be the problem of making the synthesis, as the

final map formed from for example ten individual opinions is a task not to be taken lightly, and the result would probably mostly reflect the one person's view of the field.

3.2 Support methods phase by phase

3.2.1 Problem setting

The goal and scope help characterize the process and aid the facilitator in keeping the discussions relevant. Ralston and Wilson (2006, p. 51.) even go as far as writing that it is difficult to overemphasize the definition of scope and objectives, for example, if the greatest uncertainties are forming a technology roadmap for research and development projects, the determinants are the organization's own path and capabilities compared to the rivals'. Similarly, the time span may be five years for R&D, or ten years for general strategy. Nevertheless, meaningful scenario process would need answers to following questions: what is the goal of the process, what information is needed, who will (need to) participate in the process, what methods are to be used, what is the schedule for the process, what questions the scenarios aim to answer, what is the time span, and so on. What goes for participant selection, the group composition should depend on the objectives, but as a general guideline there are three cornerstones for selection: first the senior managers of the organization in question, staff form planning, middle management and technological/R&D functions, and outside experts as needed (Ralston & Wilson, 2006, p. 48; van der Heijden et al. 2002).

As in any major project involving resources and possible changes in the organization structure and direction, the senior management carries the authority to make the process work. Furthermore, if a desired outcome is to shape the mental models of in the organization to be more open, senior management with the executive power to shape the organization is not a bad place to start. Including the other layers of organization would in turn be likely to alleviate resistance to change, and especially in intra-organizational scenarios, workers from specific functions are likely to possess information not held by the senior management. Lastly, outside experts can bring fresh perspective to the scenarios, especially if the organization feels that it lacks the capacity to conduct the process on its own, or feels that knowledge of the environment or some other relative operational aspects is lacking in the organization.

3.2.2 Drivers of change

When the objectives are clear and communicated, and the actual process starts with identification of the drivers of change, henceforth drivers. Here the basic suggestion adopted on grounds of the literature review is that a GSS would be used in seeking the drivers and forming the preliminary scenarios.

The actual driver identification would then consist of using a brainstorming tool, or whatever the functionality is called in a specific application, to gather ideas for different drivers. The proposed procedure is a defined period of time for idea generation, followed by a period for writing comments on the ideas and clarification of the proposed drivers, so that there would not be ambiguity about the meaning of inputs. Depending on the amount of generated ideas, a priorization vote finishes this part of the process.

One way of giving structure and stimulating idea generation at this stage could be using the PESTEL framework as categories for the drivers. PESTEL, in fact originally just PEST, acronym stands for the Political, Economical, Social, Environmental and Legislative or Regulatory factors in the sense how they affect the organizations concerned. It presents a framework for analyzing organizations' macro environment, or acts as a checklist where different driving forces are considered, in their respective turn. (Coyle, 2004, p. 60; Johnson & Scholes, 2002, p. 99)

3.2.3 Preliminary scenarios

After working out the relevant drivers and, if the need be, selecting the most significant, there is an array of possibilities to work the preliminary scenarios. The literature is full of examples about different methods, but if a GSS is chosen as a tool, then an adaptation is needed.

The scenarios in this report are formed by taking a page from Blanning and Reinig's (2005) book and brainstorming for events based on the identified drivers. There could be categories based on PESTEL like in the driver stage, categories such as internal, stakeholders, microenvironment, and macro environment. The point of this exercise is to have a large set of events, which are derived from the drivers (see Figure 3). When there is sufficient amount of events, say 50-100, the events can be again commented and prioritized, leaving the most insignificant out if there is a need to lessen the amount of events. The catch in this approach is that the group votes (or otherwise assigns) a subjective probability and impact factor for each event.

In this stage, Blanning and Reinig (2005) propose that the events are projected to a scatter plot where probability 1-100% forms the x-axis and impact from very negative to very positive forms the y-axis. The scenarios are then grouped by selecting three groups of 10-20 events, so that most probable events form a realistic scenario, medium to high probability events with positive impact form the positive scenario group and events with medium to high probability and negative impact form a negative scenario respectively. One critique for this event would be that the selected scenarios are not very 'scientific' as the selection of events is ostensibly random.

There are of course possibilities for furthering this process. One that would suit it is cluster analysis for grouping the events to sets by the individual impact vectors or position on the scatter, whatever is the preferred expression (Markóczy & Goldberg, 1995). Cluster analysis has again wide range of methods, or algorithms to group the given dataset and the possibility of clustering error often demands some form of manual elicitation for meaningful results. Generally, cluster analysis, or clustering, is a wide array of mathematical methods and algorithms for grouping similar items in a sample to create classifications and hierarchies (Witten & Frank, 2005; Everitt et al. 2001). As the scope of this study is not to review clustering methods, so the theory on the subject is kept succinct. Following Everitt et al. (2001) the case in hand would be identifying groups of events according to similarity. Using clustering would then ensure that the sets are consistent in the sense that their probabilities and impacts are close by in a given set. Then again, this approach could be criticized on grounds that, although methodically sound, using clustering would not bring anything to the scenarios *per se*. Using any method or other in grouping the events does not actually give more consistency in the substance level unless

the method scans the events based on *logical cohesion* of the events themselves, not just the impact vectors. Either way, use of clustering may very well be justified by matching the participants' methodological criteria, and the grouping of events has to be done in some reasonable way, but actual gains from using these more sophisticated methods is not axiomatic.

3.2.4 Evaluation and revision

The next phase in the process is evaluation and forming the final scenarios. In this GSS driven scenario method, what arrives to the evaluation is a bunch of drivers and events and voting results printed from the GSS. Depending on the actual conduct, the first stage is to take the events and scrutinize them as a group to evaluate the logicality and causal or temporal relations. As suggested above, a mapping technique of preferred flavor could be a useful sense-making tool in this stage. The objective in evaluation is to judge whether the scenarios cover the intended scope and timeframe adequately and are they logical enough frames for the final stories.

After initial cleanup of data, the first phase would be to inspect that the events are reasonably logically grouped and possibly adjust the grouping carefully. A good basic move could be checking the results for traces of rigging the votes, for example by deliberately voting against supposed group average with malicious intent, a process also known as cleaning up outlier points. The second phase would be entering the events to the chosen map. If there was no correlation vote in the GSS session, the situation can still be rescued by using the hopefully plentiful comments from the events as basis for the arcs forming a concept map. In the mapping, another basic and simple analysis technique would be color-coding the events based on standard deviation of the votes.

When the maps or preliminary scenarios are ready, it could be beneficial to gather comments from the original group. Here technology gives flexibility, a basic approach would be posting the maps to a web page, and ask for comments by email. The problem of course is that if there are any responses, they can be ambiguous and if the feedback is plentiful, fixing the maps to a satisfactory compromise can be a tricky job. The savior could well be a mapping program that has the opportunity to post the maps to a server, where clients can connect and make changes to the map at their own leisure.

Then there is always the possibility that the initial scenario maps do not satisfy the audience and there is a need to revert to previous phases and make revisions or start with a clean slate. As with the challenges of scenario process (Table 3) the reasons can be varying; the method might not seem right or trustworthy, the scenarios might not seem logical or plausible or the results do not simply seem right. In the first eventuality, there is little choice but to change the method and call forth another session. Logicality might be improved by a simple revision or if there seems to be a fundamental flaw in the scenarios, it might need a new session for corrections. The lack of subjective trust in the results or overcoming the vested interests of the participants might well be the hardest obstacle to overcome. If all else fails, leveraging managerial power of senior members of the group might be the only option to get reasonable results. Of course, if there is also the happy coincidence that the results are approved by the group only with minor modifications and the maps can move relatively straight to the second last phase.

3.2.5 Final scenarios

The last phase before implementation is the writing of the final scenarios. Hopefully in this stage the participants' collective wisdom is condensed in the scenario maps and GSS printouts, and the task of writing the final scenarios is question of making them credible and bringing them to life. In short, the objective is to use the preliminary scenarios, and write up credible stories how the identified events for a causal and temporal chain from the present to the end state, including the driving forces and how they act in the chains.

There seems to be a shortage of practical advice about writing the actual scenario stories, but at least some guidelines have been established. One reasonable question is that how long the stories should be. At least two sources propose that around ten pages (per scenario) should be adequate (Flowers, 2003; Schnaars & Ziamou, 2001). Similarly for example Shell scenario team publishes two sets; one of ten pages a piece as a sort of quick reference and the other set with much broader set of research material and analysis spanning across tens or even hundreds of pages (Flowers, 2003).

Van der Heijden et al. (2002) offer some general advice for the writing; for the stories to be credible, the writers should think of the roles and the actions of the key actors and other driving forces and illustrate how their action lead to the supposed events in a scenario. The proposition is that a human perspective makes the stories more interesting and credible. Flowers (2003), who also has been a part of the Shell team, phrases this more poetically. In her view, the scenarios should be written so that they resemble the stage of a theater, and the managers who read the stories would then act on the stage. The catch in this 'unscientific' view is to make the scenarios more memorable, as volumes of facts and figures rarely stick in one's memory as well as a concise and anecdotal little story. On a more serious note, Flowers (Ibid.) adheres to a method where she tries to pick a central theme or a definitive aspect in a scenario, name the story after the fact and build the rest of story around it. Similarly Neilson & Stouffer (2005) use very colorful and popular language in their scenarios and embed the hard facts in the stories.

As for the more practical prescriptions of scenario writing, Ralston & Wilson (2006, p. 125) put the pressure on weaving the drivers and events together to form a bigger picture of the development. The stories should describe how the drivers affect the events; describe the relationships, temporal and causal, between the events leading to a described end state. To summarize, the stories should (Ibid; Flowers, 2003; van der Heijden et al. 2002):

1. Explain the core logic, or central theme, of the scenarios
2. Describe the cause and effect relations between the elements
3. Have a description of the end state and how thing have developed to that
4. Highlight critical events, or decision points, in the scenarios
5. Include an introduction, the main narrative, preferably with illustrations, and summaries for comparison between the scenarios.

In this case of the supported process, the first approach that comes to mind would be writing a set of short stories based on the session results, using the formed maps as the core logic, and attaching some of the GSS print outs as reference material. Using some additional literature for validating the results could improve the trust in the results.

The scenario writing is a relatively simple phase if examined from the support angle. In the writing process a group of people, possibly a lot smaller than the original group of participants write a document, so the first support method that comes to mind is groupware. Groupware possesses tools for organizing work and sharing documents between people working on the same assignment. Document sharing for example could potentially make handling different inputs and versions easier and reduce needless back and forward email traffic usually associated with group work. Then of course, calendar and instant messaging functions could ease the pain in coordinating schedules and offer a chance for quick consultation without leaving the desk.

3.3 Process summary

As a product of the literature study described above, this study has arrived to a point where an attempt at making normative statements is possible. Referring to the available types of scenario methods, the domain of these considerations are the intuitive-logical and, with some reservations, heuristic scenario methods. This chapter has aimed at forming a feasible intuitive logical method for scenario creation and binding the proposed support methods in the steps in a manner that facilitates information exchange and by those means would, figuratively speaking, create a breeding ground for knowledge about the future operational conditions of the organization in question.

The process used as a platform is the generic process proposed above and the method, which is described above, is an adaptation of the works of many practitioners and writers respectively referenced. As a summary for the process, Table 6 illustrates the specific challenges in each stage and the tools that can be used to facilitate the process. As can be observed, the challenges and requirements vary through the process, which creates its own problems as one single software solution or technique as of today cannot effectively mediate the whole process.

As the table suggests, the main tasks are proposed to be carried out in GSS sessions. The actual use of GSS would depend on the available facilities and experience in using the system. The testing and exemplary scenarios presented in this study are formed in a single face-to-face synchronous GSS setting, but the session could just as well be decentralized or even asynchronous. As discussed above, the limiting factor in GSS or any other support method just as well, is often the experience of the users. The facilitated decision room session is often the safe choice if the participants are not used to working with computer mediation or the systems are not tested in different setting before.

The timeline for the scenario process is another matter, the test sessions were one workday or less each (Piirainen, 2006) and the phases that were accomplished were mainly identification of the drivers of change preliminary scenarios and evaluation to some extent, but that can be considered as the absolute minimum. Thinking of the process phases the natural division would be three sessions using the second proposed process, firstly the drivers and driver map, the events and the evaluation when the scenario maps are ready. As

pointed out in some instances, GSS sessions are individuals and it is difficult to give exact time specifications as the amount of sessions is still very little. Outside the decision room, time spent on the writing of the final scenarios and implementation may vary a great deal. Ralston & Wilson attempt to offer a ready timetable for the whole process, but in actual situation 'mileage may vary' so to speak.

Table 6. Challenges and support methods in the scenario process

<table>
<tr><th>Problem setting</th><th>Drivers</th><th>Preliminary Scenarios</th><th>Evaluation</th><th>Final scenarios</th><th>Implementation</th></tr>
<tr><td>Main challenges</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Reasonable and clear objectives and scope</td><td>Cropping the relevant drivers</td><td>Recognizing relevant and significant events</td><td rowspan="2">Assurance of the participants</td><td>Preserving the underlying logic of the group</td><td rowspan="3">Instituting the scenarios in strategizing and/or daily management</td></tr>
<tr><td>Choosing the participating group</td><td>Fusing the collective knowledge of the participants</td><td>Elucidation of events and underlying logic prior to vote</td><td>Compromising between level of detail, length and style</td></tr>
<tr><td>Gaining the trust of the participants</td><td rowspan="2">Covering all aspects in the scope of the scenarios</td><td>Interfacing the events logically to the drivers</td><td rowspan="2">Getting the attention of the group to actually validate the results</td><td rowspan="2">Making the scenarios realistic and interesting, without alienating the readers</td></tr>
<tr><td>Choosing the (right) methods and means</td><td>Getting the causalities and time line right</td></tr>
<tr><td>Tools</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>GSS</td><td>GSS, Mapping tools, Clustering,</td><td>Mapping tools, possibly GSS</td><td></td><td></td></tr>
</table>

4 SCENARIOS IN ACTION - LUT 2016

4.1 Process description and outcome

This chapter is aimed to raise the validity of the scenarios by letting the reader to judge the method and decide whether to trust the result. The material used in the scenarios is gathered in two decision room sessions in the former GDSS laboratory, nowadays Laboratory of Innovation Management in the Department of Industrial Management of Faculty of Technology Management. The decision room is used for teaching and research in the field of group decision support processes and systems. The decision room has been designed to support up to ten-person electronic meetings, and there is a possibility for remote use from within the University. The main group support software of the decision room is the GroupSystems developed by the University of Arizona and Ventana Corporation. The GroupSystems contains all the general characteristics of GSS software. The facilities are specifically constructed for supporting use of GSS, including a big horseshoe-shaped table that faces a large screen and a PC with an adequate display for each participant in the decision room.

The sessions were held during May and June of 2006. As implied in introduction, the sessions served a dual purpose of testing the developed framework for utilizing group support systems in scenario process and of course to produce material for the scenarios. Participants for the sessions were respectively administrative and research staff from the Department of Industrial Engineering and staff from different departments and administration of the university. The following scenarios are based mostly from the second session of the series, as the background of the participants were more diffuse, the execution of the session went smoother and the gathered amount of material is greater, although the report below describes some aspects from the fist sessions for comparison. This chapter focuses mostly in the phases after the initial scenarios are formed and it is time to form the final scenarios, although certain amount of overlap with previous chapters is unavoidable. The details of the first phases of the process are documented and tested fully in Piirainen (2006) and Piirainen et al. (2006). The process is illustrated in Figure 7, the problem setting was presented in the opening presentation, and the session proceeded according to the general process presented above. After evaluating the results, the laboratory session ended, and the reset of the work was done by the writers of this report.

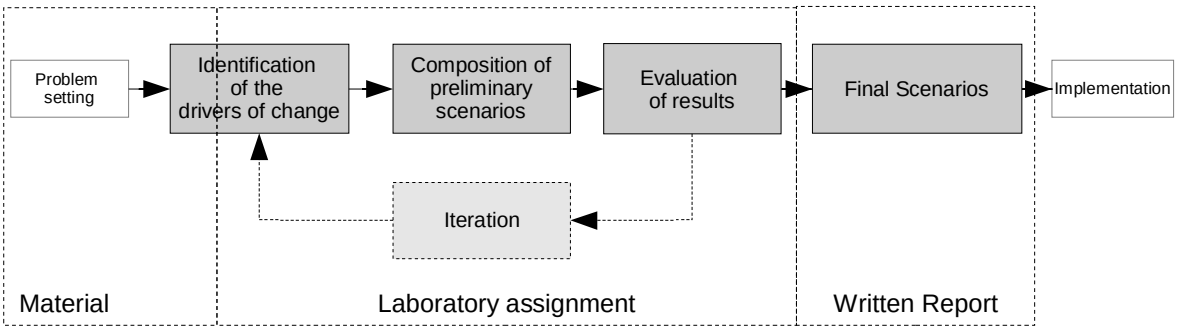

Figure 7. Illustration of the empirical testing in relation to the generic process

4.1.1 Laboratory assignment

The first step, definition of the problem was made by the facilitator, who presented the group with a summary of the exercise and a short introduction to PESTEL analysis. PESTEL is an acronym, standing for political, economical, social, technological, ecological and legislative issues which may affect the organization in question (Coyle, 2004; Johnson & Scholes, 2002). Introductory presentation is of course standard issue in any session, and the purpose of preliminary PESTEL was to 'warm-up' the participants, as it was not self-evident that everyone would be familiar with the concept.

The work progressed to the next phase where the group brainstormed the key drivers of change and uncertainties. As presented above, these scenarios could be characterized as type D, so the focus in PESTEL was in external factors. The PESTEL was also used here as preset categories for idea generation, and the facilitator went the categories through one at a time with the group. Brainstorming was followed by a discussion where ambiguous items were clarified between the participants, by verbal explanations and additions to the system. Unclear items were rephrased or explained by comments and overlapping items were removed or merged. After the discussion, the drivers were prioritized by voting. Ten-point scale was used in all the voting through GroupSystems, as it allows accurate weighing and does not have a neutral point, so participants are forced to take a either negative or positive posture.

After the identification of drivers and discussing them, the participants were asked to identify concrete events that are consequent of the identified drivers. In the first of the sessions, the subjects started with a blank screen and a printed list of the identified drivers, in the second session there were three base categories, internal, interest groups, micro and macro environment. The resulting event sets were once again discussed and commented, and overlapping events were merged or removed.

These events were then subjected to voting in two dimensions with alternative analysis tool; first the impact of the event and then probability. The ten-point scale was interpreted here so that in probability vote the 10 is read as 100% and 1 as 10%, with impact 10 was set to being extremely positive incident and 1 highly negative in respect to LUT's future. Then the scenarios were formed on grounds of the voting, so that events that had high probability were grouped in "realistic" scenario and event with average to high probability and most negative or positive impact were grouped in negative and positive scenarios respectively. In the final stage the event forming each scenario were subjected to discussion with concerns that was the set logical and coherent and the events were also grouped in approximate chronological order.

4.1.2 Written report

As reported above, the scenario sessions started with orientation and a short discussion on the topic of the future of LUT in the next ten years. The actual work started with identifying the essential drivers of change and a vote to prioritize the identified drivers. After the drivers were prioritized, the process moved on to generating events based on the drivers and finally the events were voted for impact and probability. Lastly, the scenarios were briefly discussed and the events of each set were positioned in an approximate chronological order.

What this means in practical terms to the scenario writer is that the results are present in a large text file exported from GroupSystems. The output might depend on version of the program, but basically the log contains the input of each phase of the session, first in the original order as the items were created and then vote results in descending order by rank. The votes include frequencies of different points, sum of points, mean and standard deviation per item. The systems is hard coded for anonymity, so it is not possible to identify votes or created items from different workstations. For practical reasons the original logs are not included in this report, as the output file spans some hundred pages per session in Rich Text Format. However, Table 7 below presents the drivers from each session ordered by rank of importance. The drivers are translated and rephrased from Finnish. The original Finnish and rephrased English drivers and events are also featured in Piirainen (2006).

Table 7. The most important drivers of change for LUT, ordered by importance

1st Session	Avg. (Std. dev.)	2nd Session	Avg. (Std. dev.)
Strong concentration of universities in Finland	8.22 (1.79)	Specialization of universities to achieve high quality	8.86 (0.90)
Call for centralization of research to achieve critical mass	8.11 (1.45)	Role of top tier research gains weight as a competitive advantage	8.00 (1.53)
Ministry of Schooling reduces funding for universities	7.89 (1.36)	Competition between universities tenses and role of image increases	7.86 (0.38
Intensifying competition on research project funding	7.78 (0.97)	Cooperation between university and the industry grows	7.86 (2.41)
Co-operation with polytechnic	7.78 (1.39)	Demand for combination of technology and economics in society	7.86 (1.57)
Linking of business and technological studies	7.78 (2.39)	Globalization demands more for survival	7.43 (1.62)
Furthers shift from budget funding to research services	7.67 (0.71)	The workings of university finance changes	7.43 (2.15)
Merger of universities and polytechnics	7.67 (2.06)	Governments role as financier of universities decreases	7.43 (2.23)
Mission of university: quality research or degree factory	7.56 (1.88)	Quality and amount of available student material	7.43 (2.57)
Increasing demand for research on welfare technology	7.56 (2.01)	Amount and importance of outside funding increases	7.29 (1.98)
Quality and amount of available student material	7.44 (1.94)	Importance of schooling and research as a part of national competitiveness increases	7.29 (2.56)
Decreasing competitiveness of traditional industries	7.22 (1.72)	Shifts in demand of technologies	7.14 (1.68)
Decreasing appreciation of university degrees	7.22 (1.92)	Increasing understanding of market structure	7.14 (1.86)
Requirements of innovative university	7.22 (1.99)	Ever-increasing internationalization	7.14 (1.95)
Opportunities for long-term productive cooperation with the industry	7.11 (1.45)	Capacity to absorb new technologies	7.14 (2.67)
Teaching of mathematical subjects in elementary and high schools	7.11 (1.90)	Russia demands more attention from LUT	7.00 (2.16)
Engineering works shift to third world countries	7.00 (1.50)	Forest cluster and basic technology keep their importance	7.00 (2.52)
Effect of regional development planning	6.89 (1.96)	Economic growth in Asia increases knowledge and know-how	7.00 (3.16)
Increasing unemployment of graduate engineers in Finland	6.89 (2.03)	Importance of business ventures as users of technology increases	6.86 (1.35)
Focus and amount of EU research funding	6.89 (2.15)	Shift from handing out degrees to knowledge diffusion	6.86 (1.46)

The drivers above form the backbone of the scenarios for LUT. Comparing the two different driver sets, the common denominator seems to be concentration and specialization of universities and changing of financing structure from government issued budget funding to private sector through research services and other arrangements. Otherwise looking at the ranks seems that the standard deviation is quite high in most of the drivers, which would indicate that the groups were none too single-minded about the

most important forces shaping the environment. When looking at the individual vote distributions, the rank distributions are surprisingly uniform but it would seem that there were no actual attempts to shift the balance.

If the need be to validate the drivers, one comparison would be Kati Korhonen-Yrjänheikki's licentiate thesis (2004) made in Helsinki University of Technology together with the Finnish Association of Graduate Engineers. The drivers identified in Delphi-panel, by some of the most influential people in Finnish education and industry, are reassuringly similar than the ones above, with the exception of more present bio- and nanotechnology.

When the drivers are sorted out, it is time to look at the scenarios. At first, Figure 8 illustrates the votes from the first session in a scatter plot, where x-axis represents the probability and y-axis the impact of the event. Here the events are grouped by hand with the rule of thumb, that one scenario consists of around ten events and medium to high probability events are used (Blanning & Reinig, 2005). As can be observed, the events are rather scattered around the field, which of course presents own problems to grouping the scenario sets. What is interesting in the plot is the local inverse correlation of probability and impact, illustrated by a cluster of events near the intersection of scenarios one and two, which would point to rather pessimistic expectation amongst participants in the session.

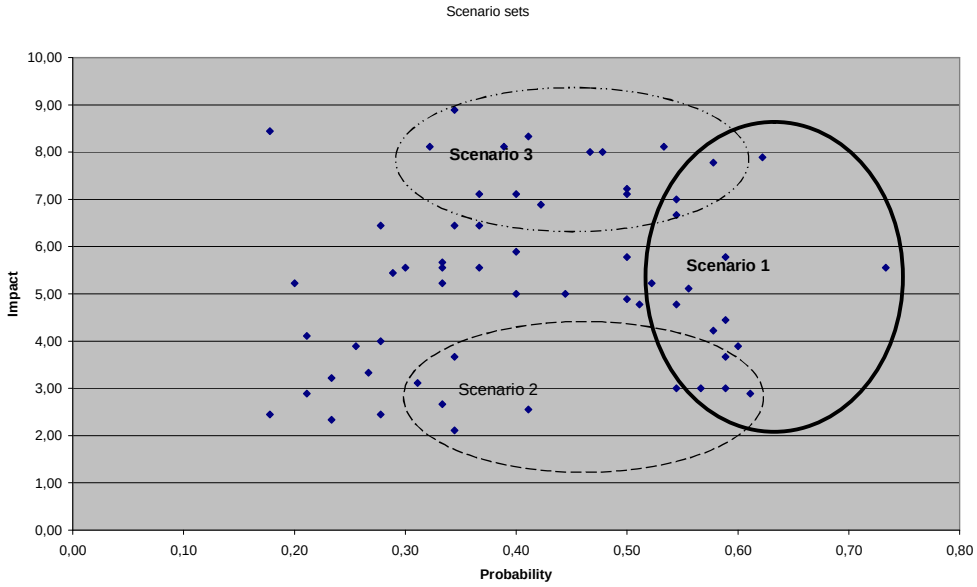

Figure 8. Scenario sets from the 1st session

As mentioned briefly in chapter 3.2.3 cluster analysis would be one possibility for doing the grouping. Figure 9 below in turn illustrates the events from the second session, drawn in Weka 3 Machine Learning Workbench's desktop. The method used was the expectation-maximization (EM) clusterer, which is based on iterative use of k-means algorithm (Witten & Frank, 2005, p. 265). Generally k-means methods optimize clusters by comparing individual impact vectors to group mean, and iterating the grouping thereof, which should be quite robust approach to the present data with unknown distributions (Everitt et al. 2001, p. 100). The figure below shows that the run with default parameters produces four

reasonable clusters which are divided roughly by lines x=0.6 and y=6, which translates more or less to two pessimistic and two optimistic sets. As discussed above, the sets are examined manually for apparent clustering errors.

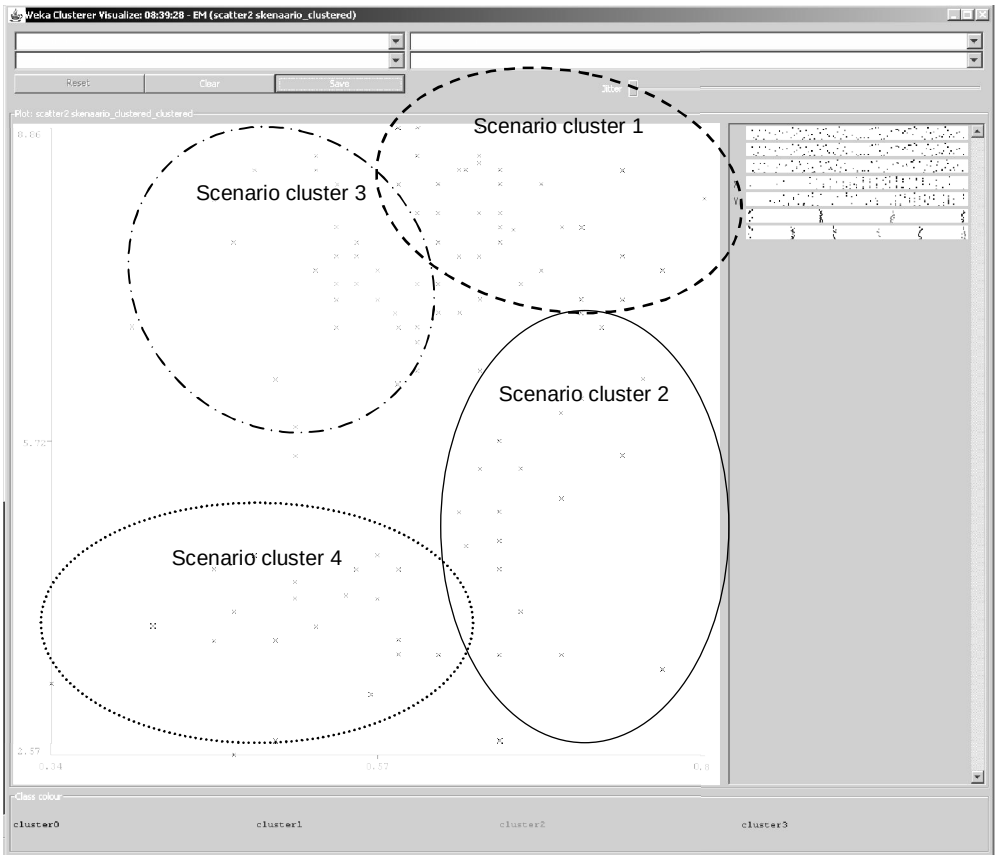

Figure 9. Clustering of scenario sets from the 2nd session

Based on examination of the collected material, the decision was to base the final scenarios on the second session. The rational is also discussed above; the second session had participants from a wider gamut of organizational levels and functions, which better adheres to guidelines for scenario formulation, and the amount of material was greater, giving a chance to achieve more seamless paths based directly on expert knowledge. Although proposed, the rule of thumb method was also overruled and the mass of events from the second session were more dispersed in probability and impact, so the final grouping was made by cluster analysis.

After the scenario sets are formed, it is time to form the scenario logics around the sets. The event items and their comments are used to form concept maps manually as a basis for the actual scenario writing later on. The starting point of mapping is sorting out the events in the scenario sessions. One approach to the mapping would be using the principles of so-called systems thinking to ponder about the cause and effect of the events inside each scenario. John Sterman (2000, p. 10) sheds some light on the basics of social systems: feedback loops (of information) are the source of growth, cause and effect usually are further apart in time and space that is intuitively perceived, delays in feedback cause the system to perform different from the intended. Sterman (Ibid.) stresses the importance of understanding the systems in question, as changing one parameter may have surprising

consequences when the system adapts to the new situation. Using this analogy, the drivers of the scenarios form a system and the system's cycles result in the events, much in the same way as Figure 3 pictures the elements in scenarios.

The general advice in mapping (Novak & Cañas, 2006) and systems thinking (Sterman, 2001) is to start carefully with few central elements and expand the map as needed. The approach here was to take the drivers and form the map of them to get a view of the forces shaping the scenarios. Then the work proceeded to examination of the events' comments and forming basic frames based on them. In mapping one impeccable rule is Emperor Marcus Aurelius' catch phrase "For any particular thing, ask, 'What is it in itself? What is its nature?"' (Aurelius, 2001). The elements were added the mapping tools workspace one by one forming the probable links with constant referral to the drivers and comments.

After the maps are created, it is time to start working on the stories. After advice of Coyle (2004, p. 61) and Ziamou (2003) the names for the scenarios were picked after examining the general theme in the scenarios. The mapping as a process went so that the events were fed to a cognitive mapping program, IHMC cMapTools, and the links were drawn. The primary source of links was again the comments from GroupSystems log, and secondarily reasoning based on the driver maps and common knowledge. In this case, after initial maps were drawn, they were presented to some of the closer colleagues familiar with the sessions as a sort of focus group interview, to test the reactions and validate the logical structure of the maps. The revised concept maps or the scenario maps are presented in appendices 1-4.

The final stories are written around that theme following the logics in the maps. During the writing, as the story unfolds so to speak, the maps are subject to some minor adjustment. Otherwise, the writing is a fairly straightforward process of tying the events together as a logical story, from present to a defined state in the future. During the writing, some background checks from literature concerning similar issues, for example from exploratory studies or public scenarios might be in order. Previous works, such as publications by government bureaus, research organizations and similar instances, gives the opportunity to test and challenge the writers own perspectives. Of course, the matter is not so straightforward, as seen below much of the reasoning and effort in writing the exemplary stories was used in analyzing the drivers and their effects on the matters. Careful examination of the drivers aids considerably in forming the scenario logics and reverberates in the stories, as well as in the scenario maps. One might characterize the process as iterative, as a resonance between the drivers and the scenario maps conducted by the writer.

4.2 Overview of the scenarios

As a first glance at the drivers in Figure 10, the *gestalt* seems to be that in the wake of globalization, the competition in the economy tenses and markets becomes more transparent between nations, which increases needs for internationalization in organizations. At the same time, as the government decreases budget funding, the financial structure of universities shift toward private funding from partners in the industry, which leads to a cycle of closer co-operation, but also demands more from the universities as the funding companies need to get their money's worth, and so the competition between universities tightens. It seems that according to this map, the key to success would be

developing top tier research programs, to attract students and partnering firms. Succeeding in this venture would need developing market understanding, absorptive capacity and wise choice of areas of expertise, while not turning too far away from traditional manufacturing industries.

Examining the forces by Schoemaker's (1995) rules, there are no apparent flaws in the drivers, in the sense that the drivers are on par with timeframe of ten years, perhaps except for Asia surpassing Europe economically. However, there is one critique on the drivers; if the map is examined for what it is in itself, the true drivers might be increasing global rivalry in economy and education, and the decreasing budget funding by the government, which together have repercussions, which are represented by the rest of driver items. This may not be such a negative thing, as Sterman (2000) eagerly reminds that human perception of causality is indeed bounded, so the map should give a fairer view of the situation than using just two or so drivers.

To pursue the system analogy presented above further, the drivers were also presented as a cognitive map to investigate whether there are apparent feedback loops. This approach is also supported by the elements in lower right corner of Figure 10, where the three concepts form a self-reinforcing loop. The cognitive map in Figure 11 was made paying attention to Sterman's (2000, p. 135) advice.

The figure includes four distinct self-reinforcing causal loops. Loop labeled as number 1, is the financial loop, where decreasing budget drives the university to seek comfort in cooperation with the private sector, which in turn decreases dependence of government funding. Loop 1 is also fed by loop 2, where shift in technology undermines basic industries, which raises importance of new business ventures and so on. Loops 3 and 4 in turn tie these two together. In loop 3, emerging technology raises importance of education and research as a competitive factor, which stimulates quality improvement in education, raising absorptive capacity, reinforcing the ongoing in shifts in technology. Loop 4 adds competition between universities acting as a catalyst in technology evolution.

The selection of map types was pondered upon above, and the result was something in the lines of choosing the one that is more convenient. However, comparing the two maps presented below, the output of them differs. These two figures provide more insight to the matter. When comparing the maps above, they seem to address different questions; the concept map seems to tell a story of what happens and how, whereas the latter cognitive map provides a better answers to questions beginning with "why". Similarly than the scenario maps in the appendices, the concept map tells what is happening and how the things might develop, which event leads to which and so on. The cognitive map, on the other hand, pictures how the drivers interact. The difference is that now the cause and effect in the drivers, or driver system if you will, is more explicit which clarifies why the scenarios are shaped as they are.

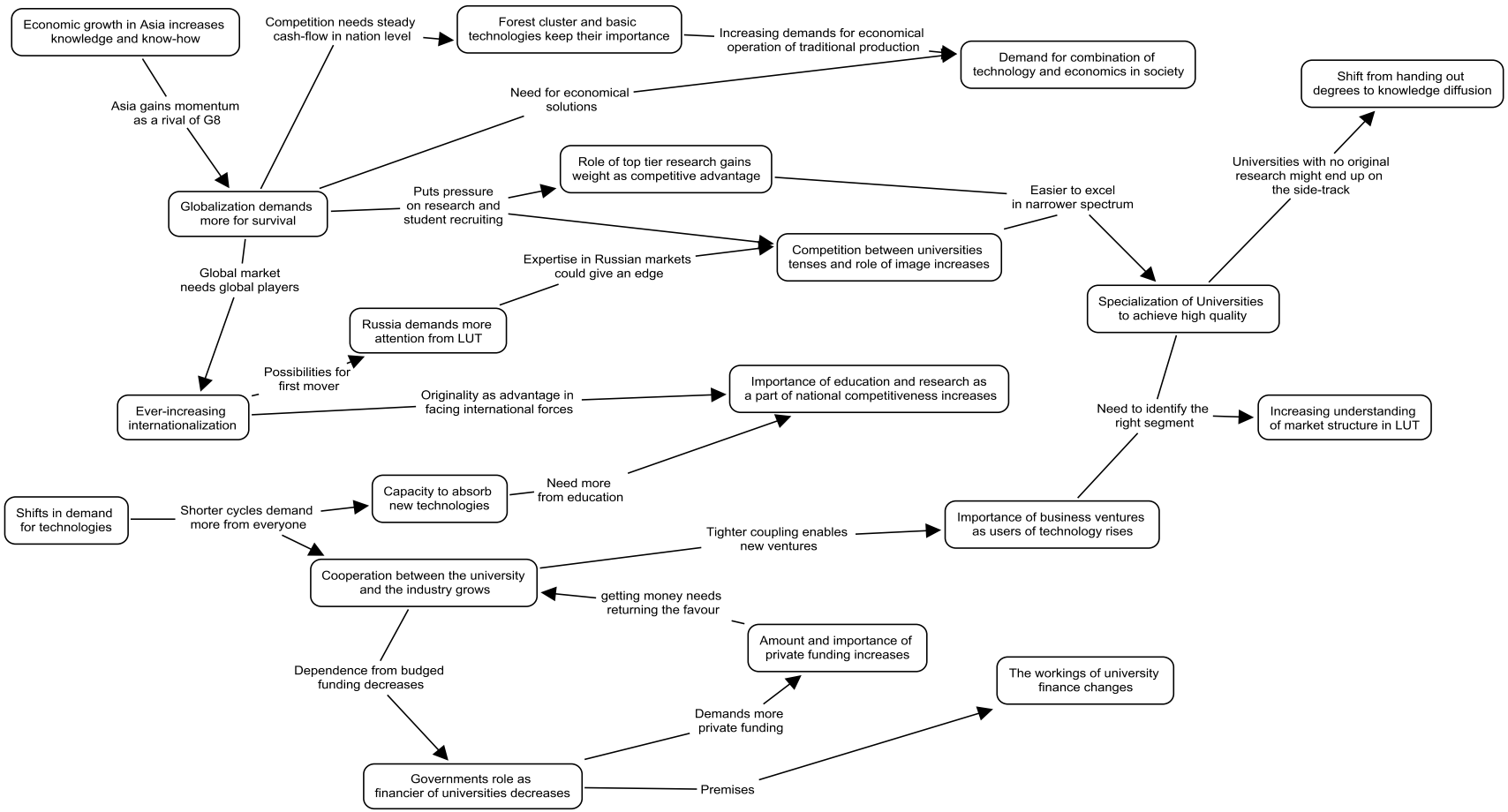

Figure 10. A concept map of the drivers of change for LUT

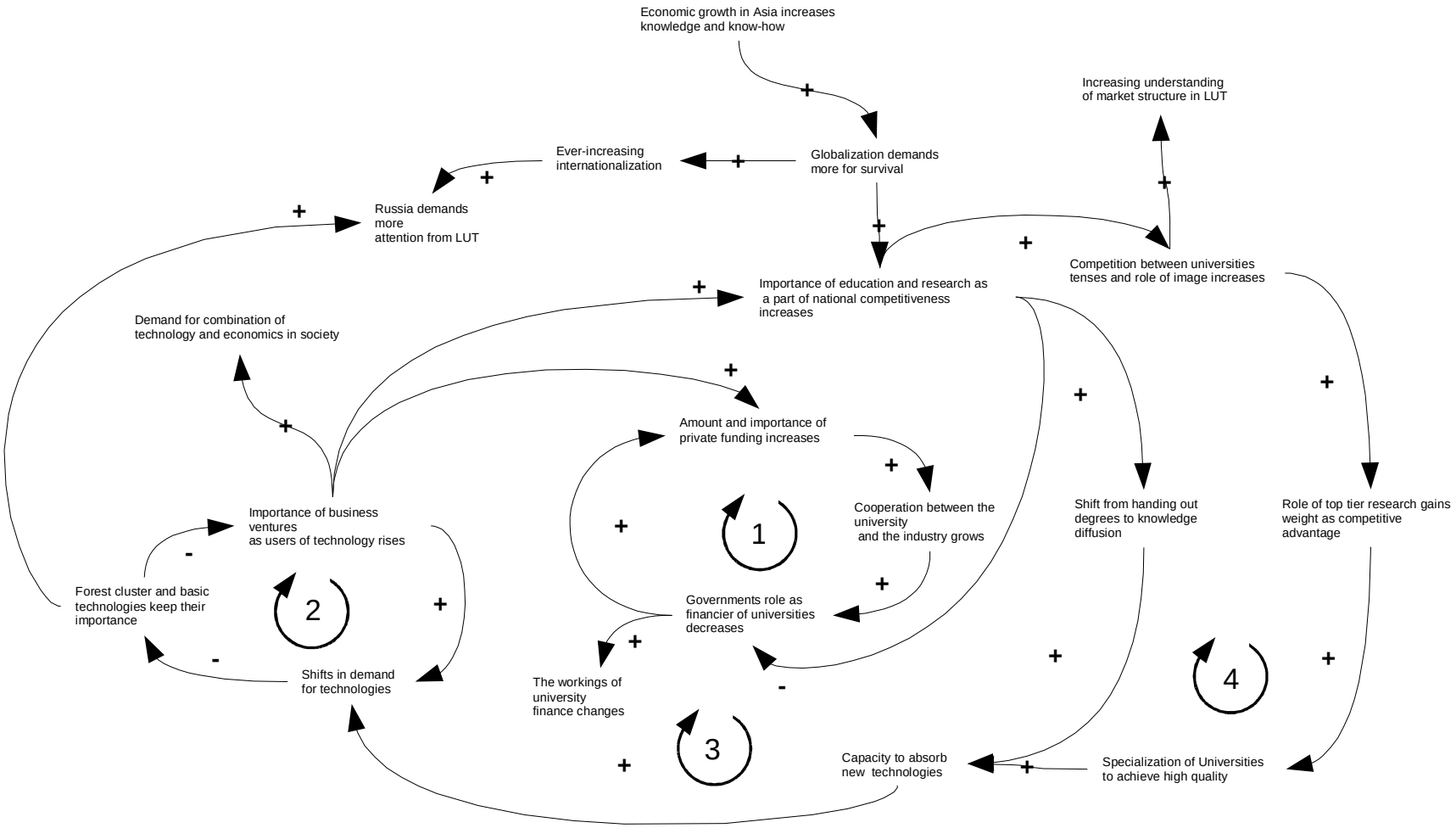

Figure 11. A cognitive map of the drivers of change for LUT

Nevertheless, what is debatable is the underlying cause for these feedbacks. It would seem by the map that growth in Asia would be the root of all evil so to speak, but that would be perhaps too straightforward interpretation, for example the shift in university finance has already started without much pressure from Asia. Some readers might also feel compelled to criticize the maps on account that even though the items were a product of the experts participating in the sessions, the maps lay on the writer's narrow shoulders. That is a reasonable critique, and hard to dismiss straight out of hand. So let us examine the map critically. The change in governments position toward universities is reality at the moment, the ongoing profitability programs, new incentive programs, funding based on the number of graduated students and so on reflect the change (e.g. Ministry of Education, 2004). Also, universities are in the face of severely conflicting interest. The first duty is to produce high international quality research and teaching, but at the same time universities should stretch their budget to provide innovations to domestic firms for supporting competitiveness and employment, while catering for demands of regional development and social effectiveness (Science and Technology Policy Council, 2006; Ministry of Education, 2004).

The matter of globalization is a harder point, it can be argued that the constant strive for international free trade, global capital markets, increasing international trade and such are the ripples of underlying change in paradigm. Similarly, others as Shell Global Scenarios (Shell International Ltd., 2005) and Kokkonen et al. (2005) have identified globalization as one of the key drivers in their work. Overall, if there is strength in numbers, similar driver constructions have been put forward in scenarios for public and education sector by the Finnish Academy (Suomen Akatemia & Tekes, 2006), Finnish National Fund for Research and Development (2005), Finnish Association of Graduate Engineers with Helsinki University of Technology (Korhonen-Yrjänheikki, 2004) and University of Sussex, United Kingdom (Berkhout, 1998).

One concern is what if the system turns backwards; globalization is taken as a sort of exogenous, given fact, in the consideration throughout the scenario material, what if the Western world finds a competitive edge somehow after all, or closes the borders? Hilmola (2006) points out that in the light of the long cycle theory, the economy is eating the fruits of the fifth innovation wave but the starvation might be in the horizon already, which could cause Asia to gain relative advantage. In a contradicting situation where globalization stalls, Shell's Flags scenario (Shell International Ltd., 2005, p. 103), economic growth is seen as hindered by trade barriers. Especially in Asia as export demand drops, but also in EU, which in contrast to the initial interpretation, would actually not lessen the importance of research in national level, or put more budget funds in universities.

Figure 12 pictures the general themes in the stories. The scenario maps are presented in appendices 1-4. There are four distinguishable themes in the scenarios. One path leads to isolation and slow degradation of abilities because of lack of renewal in the organization, the other is a path of stagnated development, where the future does not hold much positive, but neither will it lead to complete demise. Then there are two upward paths led by internationalization and warm relations across the border, or by organic growth through specialization and networking. Interesting factor is that depending on context in the scenarios, diminishing budget funding is seen as either a source of economic autonomy or a severe threat. Otherwise, the nuances in each scenario map are quite distinct, as figure

below tries to suggest that despite similarities, there are separate paths that lead to different outcome.

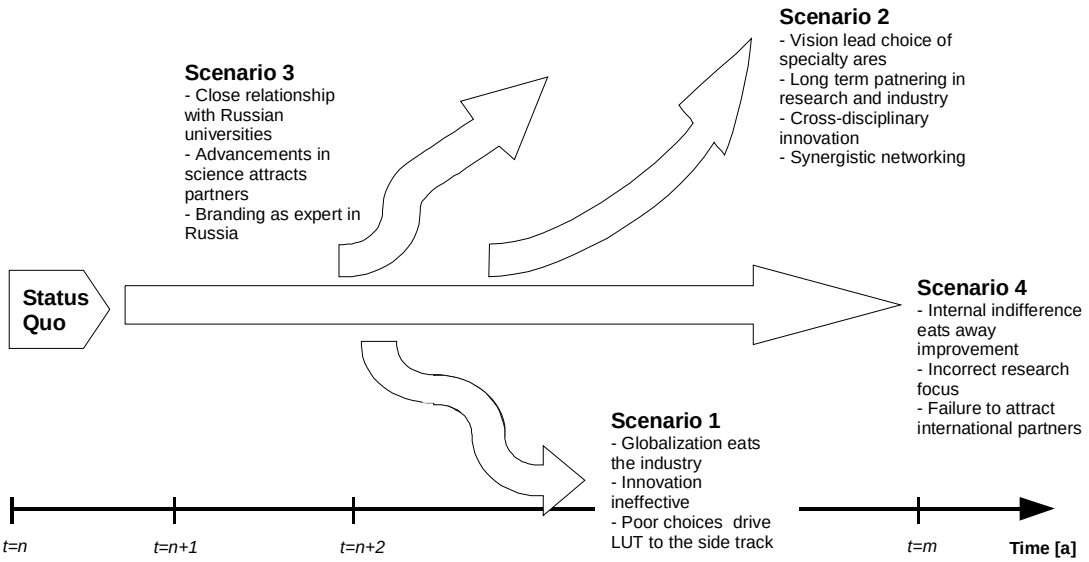

Figure 12. Overview in the scenarios

Examining the scenario material, it would seem that the differentiating factor in the scenarios is, same as in the drivers, very much the ability to develop international relations and the level of innovation and scientific accomplishment. As for the stories, the descriptions feature the actual story and a table each, which ties the main events with the drivers. Figure 13 sums the driver map presented above to condense the essence of the drivers to be used in abstraction of the scenarios.

As a disclaimer, it is to be noted that base material used above and the following stories are firmly based on the consensus of the participants in the test sessions, and thus these scenarios are not just figments of the writer's imagination. The writer's humble role is to phrase the gathered ideas as stories of the future, so to speak. As the purpose of scenarios is to give picture of plausible futures and to challenge present worldviews, the style in the following sub chapters may be polemic in nature. It is also notable that despite some suspicion the drivers seems to form a reasonable construction and the events or scenarios do have a connection with the drivers. Whether or not it is a distortion put forward by the writer, and is it a positive or negative thing, is debatable, but in any case it is aligned with the theoretical proposition, where the drivers are supposed to form the underlying logic that is realized in the separate chains of events

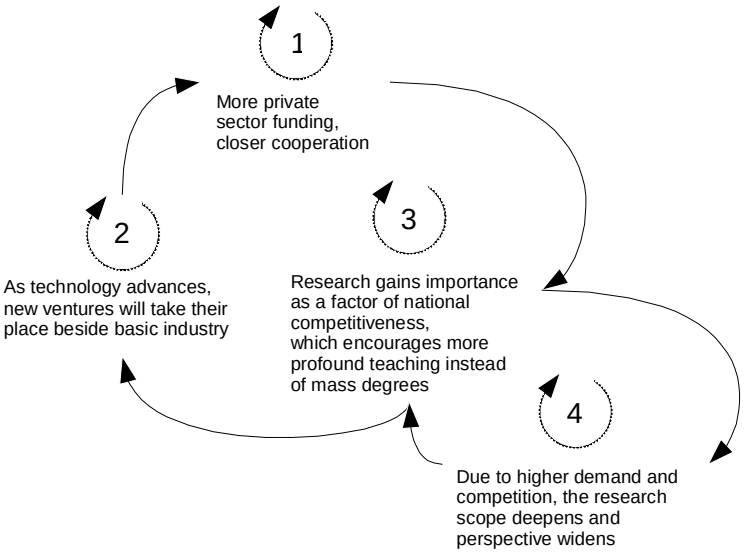

Figure 13. A summary of the driver map

4.3 Scenario 1 - Slow degrade and demise

The scenario has three intertwining storylines that lead to the final state. The premises of degradation and demise are lack of basic research, problems in traditional industries and locking into collaborating solely with incumbent companies.

The domino starts with the industry having troubles to renew itself when the society and economy moves towards a knowledge intensive paradigm. There are already some concerns. For example, Weckström (2006) has seriously warned the printing and paper industries about the future, as content and consumers increasingly move to electronic media. The intermediary has little to offer if there are no new ways to enhance customer value, the content provider is indifferent toward the used media as long as the content sells, and the consumers act on their preferences and convenience.

In present state, declining profits are patched with rationalization and cost cutting programs. Innovation and development need investments, which are costly in the short term, and managers do not want to spend any more funds when the figures are already looking poor. The quest for most efficient manufacturing drives the industry to move toward bigger markets and cheaper labor to minimize cost. The mathematics are simple, Asia has the largest potential customer base and economic growth in the world. On the other hand local industry is also recruiting from abroad, be it lack of available workforce, or worker immobility and lack of incentive, engineering works' recruit more and more from the former Eastern bloc to get willing and cheap engineers, welders, construction workers and so on.

In the mean time, the academic world fails to see the wave of change in the industry and continues to work exclusively with large incumbent companies. The views in these companies are locked to cost savings and this lack of perspective infects the scientific world. The resulting effect is a vicious cycle where researchers and managers support each

other's views and en up reinforcing the conventional wisdom. In the same time SME and start-up businesses are overshadowed by the dinosaur, and suffer in deprivation of funding, research, and business development programs. Neither banking nor government instances are willing to risk with wild ideas and uncertain future, resulting in many a promising ventures going toward bankruptcy. Before long, this results in listlessness toward ventures and entrepreneurship as there is no support. Even the potential SM-enterprises suffer and may fail to develop to the full extent. Unfortunately, the full effect of this oversight is discovered in the long run, as the western world is slowly overrun by dynamic Asia.

The growing importance of Asia means also problems to LUT as the incumbents continue to move toward the third world as they try to gain profitability by forcing themselves to new growing markets. Alas, before long the industry cuts research projects to minimum in trying to save money, and the remaining projects are concerned with savings. This development cools relations between LUT and long-time industry partners. This averseness toward research turns attention toward SME-sector, for LUT to find that local business ventures are in similar shape than the large companies, and are interested in nought but survival.

Meanwhile, the lack of interest in research and development has long since restricted basic research to only few areas of interest. The few that have the resource and knowledge to do profound research are strong in competition when it comes to practical application and division of funding. When the competition between universities escalates, the ones who have original basic research are in a strong position. Organizational changes and the new incentive system have depleted interest to do basic research in LUT. As a result, LUT turns to local South Carelia Polytechnic (SCP) for collaboration in more practical, applied research. The result is that the students who are interested in research start to seek accommodation in other universities at graduate level. This cycle also undermines the scientific base of LUT as the students who have scientific ambition leave for the rivaling institutes, and at the same time research is based on solely applied applications.

The student number of LUT has been dropping for other reasons too, the attitude climate in the society as a whole has turned toward education of the more practical persuasion. The attitudes reflect the disinterest to research in the large companies, and the poor position where entrepreneurs find themselves. People see a brighter future in pursuing a good solid hands-on education for a modest paying and secure job. The winners in this game are vocational education and polytechnics.

These developments cumulate in ten years time, leaving LUT with little choice but to merge with SCP. This can be seen as a symptom of failure to implement the dual model of higher schooling, as the borders and missions of polytechnic and universities become increasingly fuzzy (Korhonen-Yrjänheikki, 2004, p. 198). The overall picture in Finnish society is grim, as lack of original research has turn the path of the firms away from innovativeness and the barriers for returning are high. In the same way, society does not value higher education because there seems to be little need for it, which will make student recruitment hard and many of the more promising potential students will accommodate to foreign universities. The most important partners in the industry have concentrated in lean management and Asia has spurted to the pole position in the economy and research. It is increasingly hard to attract motivated students, as people are not interested in a career in science. When there are little graduate, let alone post-graduate, students the amount of

research staff is declining. In this situation, LUT is reduced to handing bachelor's degrees, and as polytechnic degrees are already regarded largely equal, and it does not make much sense to keep two separate institutions in the same smallish city, so the two schools merge to pursue lower administrative cost and synergies.

Table 8. Characteristics of scenario 1

Growing importance of private funding	Importance of ventures increases
- Applied projects as source of funding - Distress of manufacturing industries opens a market for research services - A risk of too narrow a research portfolio	- Incumbent companies are locked in cost reductions - A general tendency to move labor intensive work abroad - A trend toward bigger markets - A possible change in earning logic in many industries
Research as the engine of national competitiveness	Competition raises the bar in research
- Focus in the straits of incumbents steer attention away from possible new ventures - General interest in science decreases - Innovation potential is wasted - Averseness toward venture investments	- Focus in applied research - A possible lapse in scientific rigor - Stagnation in basic research - Wage system doesn't encourage profound research

4.4 Scenario 2 - Oriental Express

The general themes in this scenario are wise choices and making the most of the possibilities that the environment offers. The development is rooted in the faculty reform in LUT that is aimed to streamline the administrative organization and allow the teaching and research staff to concentrate more on their primary tasks instead of administrative duties.

The organizational reform has succeeded and the former departments manage to regroup as faculties without crippling disputes over budgeting or power. The reform gives a chance for some of the younger, ambitious, actors to step up as the new administrative bodies are formed. The working atmosphere is improved and the people feel freer to bring up new ideas and the suggestions are taken more seriously than before. In this new encouraging environment a more visionary and ahead-looking stance is adopted in the organization, as change has made way for fresh perspective and new values besides the existing.

The reformed organization promotes more vision-bound management instead of the old "this is how it has always been done". In this spirit, a true change is possible, which triggers two major projects; the research expertise is marketed to outside interest groups more aggressively, and the areas of interest are examined critically. New management attitude makes it possible to take advantage of the new economic autonomy in the form of increasing private funding offers, instead of seeing it as a risk. Change needs new perspectives, which leads to developing a more open and flexible attitude in the organization.

In the academia, research is the key in competition, which leads to pressure toward concentration. In the presence of scarce resources and tightening competition between

research units, it would be an advantage to concentrate on fewer areas to achieve higher level of expertise. This leads to choosing the areas where LUT possesses true advantage and expertise in accord with national agenda and other universities' specialties. Deliberate choice of specialization early on gives the possibility to avoid them being ordered in the future and gives an edge in competition. The flipside of the coin is, that as the attention focuses in narrower areas, the need for cross disciplinary research comes apparent, this means a shift from doing everything adequately inside the organization, to seeking excellence on the selected key focuses, and collaborating with other research teams who have supporting expertise.

In the level of goals, the existing research and assets are screened to determine what the core capabilities of LUT are and which of them show the promise of developing to unique capabilities. In the operational level these changes need incentive measures to support the vision and targets, as the goals often are forgotten if they are left to speeches. Budgeting is evaluated according to the research objectives, the monetary incentives are set toward cross disciplinary research, and the select research areas are supported in budgeting and short-term goals.

As the research and organization develops, the main attracts in student recruitment are original course palette and available subjects, and Lappeenranta as a city. This leads to closer relationship wit the city of Lappeenranta to develop the image of dynamic and growing environment, full of possibilities for students. Some departments as start to offer English subject for Finnish and foreign students alike, to reinforce the international capabilities of the people and the organization. In the general spirit of internalization and cooperation, LUT finds partners in Russia to develop common graduate programs across the border.

Meanwhile the industry is going through a similar development. As the realities of stagnating economic growth and decreasing margins hit the industry, the companies started searching ways to increase their revenue stream in addition to questing for the lowest costs. The result is traditional metal, energy and service sectors sitting around one table to find common interests and developing product/service offerings of added value. This creates an opportunity for LUT to exploit the existing relations in the industry and remain a balance in the research portfolio. In cooperation with LUT, the industry is able to find convergence in their product lines and move toward higher technology products, coupled with matching service offering. During this shift, LUT deepens the relationship with the industry, which starts as a failsafe to manage research portfolio, and ends up in strong partnership with mutual advantage as LUT's research pushes the industry toward higher technology and business excellence.

In the end of the line, the pieces of the puzzle fall in place and LUT has developed strong original base of research activities, rooting in the path of development and capabilities accumulated during the course of LUT's history. This has been accomplished in cooperation with the industry, forming a strong relationship with evolving and dynamic innovation driven enterprises, both sparring each other to higher achievements. As a result, LUT's expertise is well known and renowned, but focused in limited areas. LUT also acknowledges these limitations, and has developed cross-disciplinary network with other universities and research teams, domestically and internationally, to support it's own and the partners' core competences.

Table 9. Characteristics of scenario 2

Growing importance of private funding	Importance of ventures increases
- Marketing of research abilities and results - Economic autonomy through private funding - Partnership within industry, without sacrificing scientific autonomy	- Convergence of traditional industries - Push toward new high-tech ventures - Integration of research effort between the industry and LUT
Research as the engine of national competitiveness	Competition raises the bar in research
- Networking with other universities - Focus of research chosen in accord with national objectives	- Sharper focus of research - Concentration in and development of own competence - Reach for excellence in chosen fields - Research based teaching and original course palette

4.5 Scenario 3 - Bilateral Trading

The general theme in this scenario is the development of strong relations with Russian partners and scientific renaissance in LUT. The starting point is English Master's Program initiated at LUT. The English study program starts to attract Russian students and gives a possibility to attend to studying without learning Finnish. On the other hand, incentives to learn Russian in LUT pave the way even further.

As internationalization furthers, LUT starts to attract also Russian scholars and recruiting from St Petersburg area comes easier and more commonplace. The students also act as a bridge between their institutions and LUT, furthering collaboration in research and studies. As the time goes on, the formed network based on division of research interests, gives possibility to divest unfruitful research areas and to specialize in stronger disciplines. The development leads to branding LUT as the leading expert in Russian markets and forest industry.

Inside LUT, the faculty reform has raised new actors up the ladder in the organization, which promotes more open minded views. This gives LUT the flexibility it needs to face economic and other challenges posed by the environment. With its newfound dynamics, LUT assumes a more active position in the development of the Southeast region. As the basic industry slowly loses its attractiveness, LUT turns its attention toward the regional entrepreneurs. However, this poses new challenges as the comfort and safety of long time relations is laid aside, the difficulty of betting on the right horse in respect of emerging technologies and markets becomes acutely apparent.

The made technology choices need a certain amount of mass to back them up, so the pressure is put on LUT as the driver of technology and the regional entrepreneurs as the users. The pressure to create critical mass on the technology drives the partners closer to LUT and *vice versa*. Slowly the investments start to pay back as the local ventures start to gain momentum and the general attitudes become warmer toward business ventures and

collaboration, LUT acting as the census of the efforts. The newfound regional unity also promotes Saimaa-city project, as the municipalities in the area seek to better support economic efforts and cooperation in the area.

As LUT gains in rising to the spearhead of the region, it becomes apparent that student proficiency especially in mathematical and physical subjects needs development. LUT starts to make presence in the basic education to lobby mathematical subjects and waving the flag of life-long learning. At the same time LUT itself need to develop incentives toward cooperation, and ways to measure collaboration and intellectual resources to support the system. The spirit of sharing promotes the view that every person is working on "sending a man on the moon".

Together with the efforts in education, cooperation and tight relations to the growing ventures around the region pays off in a surge of scientific success. LUT rides the wave with its Russian partners, doing research for regional success. Only one drag remains despite improvements; the success of LUT has been mainly regional, but when more aggressive marketing practice is adopted, the industry discovers LUT's dynamic abilities. In the end state, LUT is operating in the midst of a lively region, surrounded by SMEs in different lifecycle states, and in tight cooperation with Russian institutes. This situation seems highly satisfactory, but also puts a strain on LUT, as the regional momentum needs constant input of research and capital to stay moving.

Table 10. Characteristics of scenario 3

Growing importance of private funding	Importance of ventures increases
- Local ventures and LUT support each other - Pressure to develop critical mass of technology and business ventures - Brand marketing of own expertise for private sector	- Focus in regional development - A portfolio of technology spin-offs to support technology development - Strong effort to raising ventures around the region
Research as the engine of national competitiveness	Competition raises the bar in research
- Strong relationship with Russian partners grant an opening for the industry - LUT spearheads regional development	- Branding as an expert in Russian market - Divesting non-core research to partners - Technology push research to feed local business - Diverting domestic competition through international networking - Effort to raise the quality of education regionally to gain proficient students - Focus in developing fruitful environment for research

4.6 Scenario 4 - Times of Stagnation

In this scenario, two negative feedbacks work toward stagnated development. The starting point is an organizational reform in LUT that has gone awry. The newly forged faculties are in disarray as there is no incentive for cooperation and differences in cost structure has triggered disputes over budgeting. The internal problems in LUT lead to everyone entrenching in their position and blindly asserting their positions in division of resources. This widespread opposition to change smothers the ongoing improvement programs and cripples collaboration between departments and faculties. As a result, the work atmosphere becomes unbearable to some, and meaningful research programs become difficult to manage. These events lead to resignation of the more ambitious researchers, as the prospects start to seem better with other employers.

The situation is made worse by lowering appreciation of academic degrees. The rising polytechnics allure students by promising balance between practical and theoretical subjects. One factor resulting in disinterest in engineering sciences is diminishing mathematical and physical understanding, put forward by lack of teaching in lower schooling, which will in the end strike the research of hard sciences. Aiding in the transition away from university as the first choice of higher schooling is the possibility to apply to a university for Graduate Degree as polytechnic degrees are seen as parallel to Bachelor's.

Despite of lowering interest, universities continue admission at the same level, regardless of decreased support from the Government. Productivity programs degrade quality of education, as more students have to be handed degrees, faster and with lower resources (Korhonen-Yrjänheikki, 2004, p. 66). Rising quota of doctoral degrees, together with lowering standards, undermine the appreciation of the degree, more graduates seek doctoral degree to differentiate themselves from the already vast array of masters. Korhonen-Yrjänheikki (2004, p. 60) points out that the number of doctoral degrees in technology has quadrupled since 1990 and Ministry of Education is setting new and even higher targets (Ministry of Education, 2006). Together, these developments result in collapse of applicant amount in LUT.

At the same time, Finland has failed to attract foreign students to fillip the decreasing number of applicants. Protectionism in Russia withers the promising Master's programs initiated by LUT. The international mobility of students and researchers does not develop as planned, and the hope of replacing shortcomings in applicant amount seems to dry up. Other universities in Finland have to address similar problems, and national cooperation in research and education is trampled in everyone's own problems.

As the problems start to pile up, the whiplash effect strikes LUT hard, the research partners and customers start to show signs of dissatisfaction, as the level and results of research does not meet their demands in the long perspective. Added damaged is inflicted as the industry and demand evolves, but the focal areas of scientific interest in LUT do not address these needs. In the development leads to failure in offering research services, as LUT struggles for students with SCP and collaboration with other universities in the national and international level is forgotten.

Table 11. Characteristics of scenario 4

Growing importance of private funding	Importance of ventures increases
- Disputes over budgeting and inefficient acquiring of private funding	- Difficulties in commercializing research - Research service operationalization fails
Research as the engine of national competitiveness	Competition raises the bar in research
- Cooperation is forgotten - International networking does not work	- General interest in science is decreased - Problems in finding proficient students - Profitability measures result in mass degrees, quality is forgotten - Difficulties satisfying research partners' and clients' expectations - Unwise research focus

4.7 Summary of the scenarios

Finally, Table 12 summarizes the general themes of the scenarios. As proposed above, the set seems to have two positive and two negative scenarios. The probability of between the scenarios is not considered, but as the evaluation criteria of events suggests, there may be two storylines that are more probable. The same goes for preference between the scenarios, the impact of scenarios to LUT was not considered during forming them, but there may be scenarios that are more preferable than the others are. Examining the scenario maps and the stories, much depends on successful implementation of the faculty reform and securing funding, but also choice of partners and research areas.

If the stories were considered as a set, it would seem that what it all boils down to is "I conclude, then, that so long as Fortune varies and men stand still, they will prosper while they suit the times, and fail when they do not." (Machiavelli, 1513). Clichés aside, it would seem that the probable future needs some adapting from LUT. If nothing were done, the result would be isolation and if the wrong or careless choices are made, it may lead to even worse outcome.

Nevertheless, there is also some light at the end of the tunnel. If the changing conditions were not taken as a straightforward threat but as a chance, it would seem that the outcome might just as well be very positive. When looking at the stories, it seems that the ongoing reforms in the organization and the associated change management measures will play a large role in determining future success in LUT. Change is not easy, especially in an old organization. As Churchill might say, the future holds blood, sweat, toil and tears, but also possibilities.

Now then, getting back on the ground, one might ask what the value of these scenarios is. In scenario literature, there are plenty of warnings about writing too apparent scenarios, but if the purpose of this exercise is to collect the opinions and expertise of the organization, the session results bind the writers to follow the session outcome. In the surface, the

scenario themes seem largely obvious, most administrators should be at least by and large aware of these kinds of prospects. If there were value in the stories for LUT, it would be that the future possibilities are explicitly illustrated.

Table 12. General themes of the scenarios

Slow degrade and demise	Oriental express
Theme: Industries are not able to renew in the face of disruption in earning logic, and drag LUT down Milestones: - Incumbent traditional companies struggle with profitability - LUT clings on in unfruitful partnerships and hopes for better times - Innovation overlooked - Withering of basic research and abandoning of scientific rigor - Negative trend in applications and interest to academic education	Theme: Vision bound choice of specialization and seek for excellence through networking. Milestones: - Swift and well managed organizational reform - Choice of focal research areas in accordance to national research agenda and own core competence - Clear cut strategic goals with monetary incentives - Networking to strengthen own capabilities - Long tern cooperation with the industry and research excellence in the chosen fields
Bilateral trading	**Times of stagnation**
Theme: LUT spearheads regional development through technology spin-offs and ventures and with strong relationship across the border Milestones: - Internalization and cooperation with Russian partners - Developing expertise of Russian markets - Tight relation with the entrepreneurs and business ventures of the region - Research focus based on division of interest and capability between partners - LUT acts a the census of south-east innovation driven high-tech cluster	Theme: Internal disarray prohibits renewal in LUT Milestones: - Disputes over budgeting in the faculties - General appreciation of academic education diminishes - International mobility of researchers and students does not develop - Students and young researchers start fleeing - Research does not satisfy partners

5 CONCLUSION AND DISCUSSIONS

The contribution of this report is to give a concise overview to the present state of practice in the field of scenarios in LUT and scenarios developed for the university for the next ten years. On the subject of new scientific knowledge, this study is aimed to describe an instance of scenario process and its results for study, practice and administration.

These scenarios offer some insight to how the future *could* develop. However, in the spirit of scenarios it is customary *not* to exclaim that these will become true; one scenario may be fulfilled, or some aspects from any number of them, or of course none of them, not to forget the organizations own impact to the future development. Referring to the definition, this report offers multiple plausible paths of development for the reader to reflect on. The scenarios are develop with a controlled process and documented methods, as an "act of disciplined imagination" and as such are not single line forecasts, but summaries of the participants insight and knowledge of the present and the possibilities in the future, tied together by the writers.

The first question that arises from this report is the validity and limitation of the propositions, particularly for the scenarios. In the method level, validity is open for interpretation. The method is based on fairly extensive literature review and it is tested by students and prospective users, which could deflect the possible critique toward scenario techniques in general and the expertise used for the results. The differences in methods were discussed in the first chapters of this report and the readers may draw their own conclusions, but as a concept and according to testing the method seems feasible. In substance level, the scenarios written in this report are based on the expert opinions gathered by a group support system and review of comparable foresight literature. The participants were experts in their own domain and several of them have had a long career in the academia, which should result in well-educated input in the scenarios. The main source of error that remains is the writing team and the possible biases they have introduced to the results, and this is a point that is left to the reader, as the writers are perhaps not the most objective judges in that aspect. All in all, the foundation should be solid for respectable scenarios.

As for limitations, the method itself is not limited to a particular situation as such, but the presented scenarios are of course limited to LUT and the next 10 years or less, should the drivers change radically for some reason. That said, any set of scenarios, forecasts and such will stand as long as the underlying assumptions hold. What is assumed is that the general attitude climate remains mostly the same. The single most important assumptions as can be observed from the drivers are that competition in education remains the same or tenses. If these premises fall and the world order is significantly different, the explanatory power of these scenarios will not hold.

As a result of these considerations, actual conclusion have to be left somewhat open-ended. The scenarios presented here are one plausible view of the future, whether they will be on the money, so to speak, only time will tell. The other question whether these or any other scenarios will influence the path of LUT depends on the trust they will receive from the decision makers. As pointed out in the literature, the benefit of scenarios, barring rare cases of actual disruptive change, is mostly in the process and the way scenario thinking should

widen the line of sight in decision making, which remains to be seen in action. From the process point of view, this exercise has been an interesting and rewarding one for the writers; let us hope it will be as useful for the reader.

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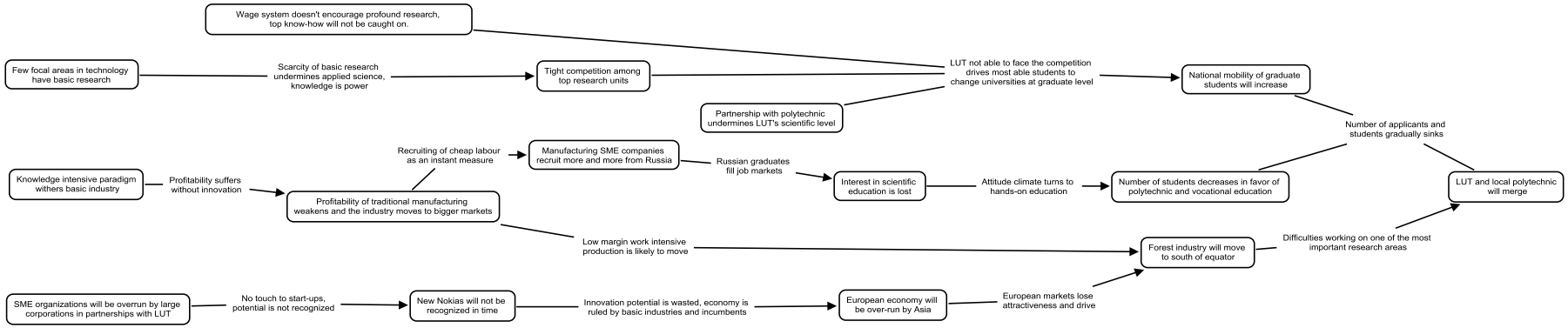
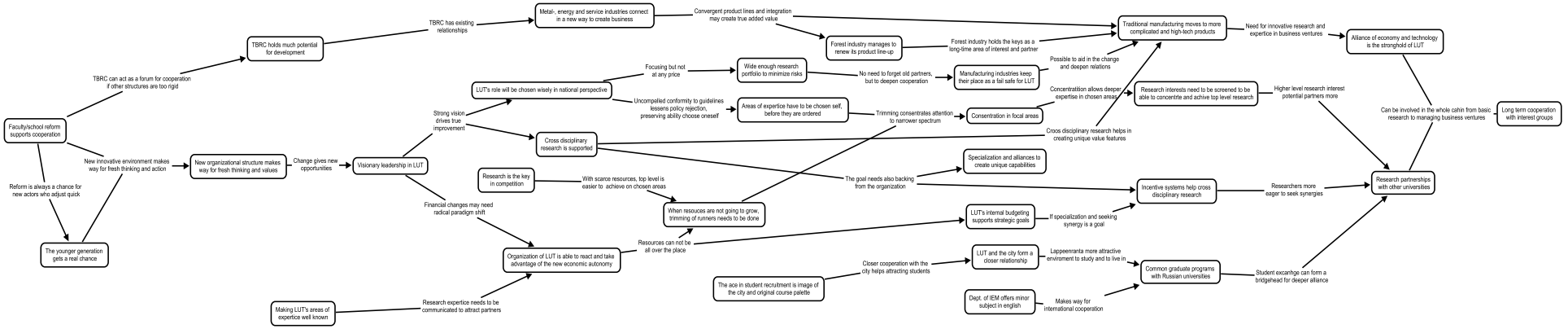
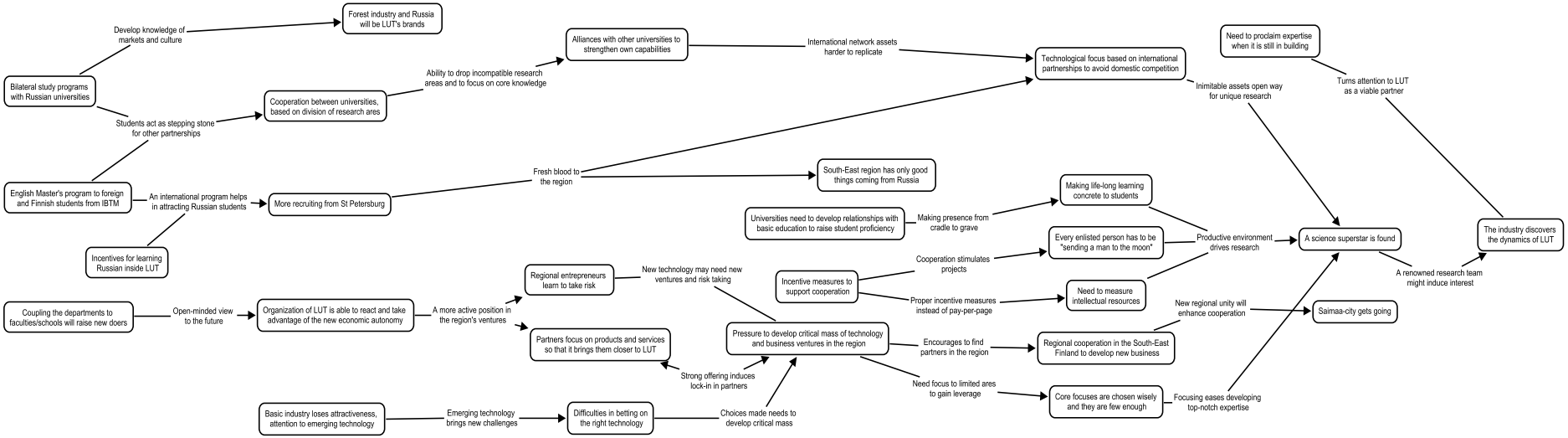
APPENDIX 1: SCENARIO 1 – SLOW DEGRADE AND DEMISE



APPENDIX 2: SCENARIO 2 – ORIENTAL EXPRESS



APPENDIX 3: SCENARIO 3 – BILATERAL TRADING



APPENDIX 4: SCENARIO 4 – TIMES OF STAGNATION